I. PATENT ABSTRACTS OF JAPAN

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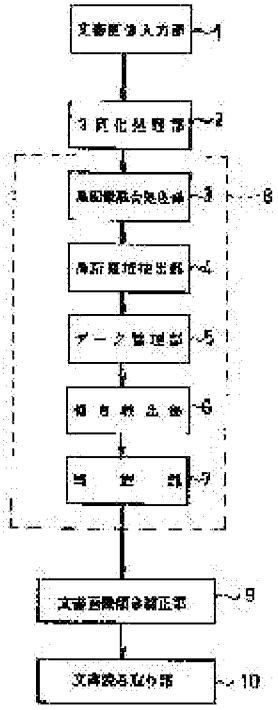
(54) DETECTION OF DOCUMENT IMAGE TILT



(57)Abstract:
PURPOSE: To stably detect tilt without affected by a figure, picture, noise, etc., whose complexity is little when compared with a character string part, by detecting tilt of an inputted characters examining complexity of the inputted document.
CONSTITUTION: A local area extracting part 4 extracts the partial area whose complexity is largest out of the image generated by a black pixel fusion- processing part 3 as a local area La. The local area La can be taken that the most of it is occupied with a character string. A data management part 5, with an intention that following processes are efficiently performed, compresses and manages the image contained in the local area La extracted by local area extracting part 4. A tilt detecting part 6 detects the tilt of the input document image using the data managed by the data management part 5. A deciding part 7, relating to the tilt angle detected by the tilt detecting part 6, decides whether the tilt of the inputted document is corrected or not.

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NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]A document image detected inclination method comprising:
A means to extract complexity of a document image for two or more angular orientation of every.
A means which detects an angle of a direction with the largest complexity and considers the angle as inclination of said document image.

[Claim 2]The document image detected inclination method according to claim 1 which makes a value which a means to extract said complexity scanned said document image to arbitrary angular orientation, calculated the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element on one scanning line, and added it with said whole document image complexity of arbitrary angular orientation.
[Claim 3]A document image detected inclination method comprising:
A means by which a character string extracts a local domain which occupies most in a document image.
A means to extract complexity of said local domain for two or more angular orientation of every.
A means which detects an angle of a direction with the largest complexity from said extracted complexity, and considers the angle as inclination of said document image.

[Claim 4]The document image detected inclination method comprising according to claim 3:
A means to divide a document image into n pieces x m mesh.
A means to calculate the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element on one scanning line in each mesh.
A means to extract i pieces x j local domains [****] containing a scanning line used as the number of times which changes to a black pixel from said most many of white picture elements, or a white picture element from a black pixel as a local domain where said character string occupies most.

[Claim 5]The document image detected inclination method comprising according to claim 1:
A means to ask for complexity of some angular orientation by angular resolution of the degree of alpha, and to extract angular orientation where complexity is among these the largest when extracting complexity of a document image to two or more angular orientation in a local domain which is the whole document image or its part.

A means to ask near the angle of said direction with the largest complexity for complexity in two or more directions by angular resolution of the degree smaller than the degree of alpha of sigma, among those to extract an angle of a direction with the largest complexity as inclination of a document image.

[Claim 6]The document image detected inclination method comprising according to claim 1:
A means to scan a local domain which is the whole document image or its part in the direction of plurality by angular resolution of the degree of sigma, and to extract complexity for every angular orientation.
A means to presume inclination of said document image by angular resolution smaller than sigma from distribution of a size of three complexity, complexity of angle $theta_{max}$ of a direction with the maximum complexity, complexity of the degree of $theta_{max}$-sigma, and complexity of the degree of $theta_{max}$+sigma.

[Claim 7]A document image detected inclination method comprising:
A means to binary-ize a document image.
A means to unite a black pixel which changes into a black pixel all continuous white picture elements below a length delta pixel which was level or was inserted into a black pixel for every scanning line at least in vertical one side, and approaches.
A means to scan a document image to two or more angular orientation, and to extract complexity of said document image for for [every] all directions to said changed document image.
A means which detects an angle of a direction with the largest complexity and considers this as inclination of said input sentence paintings-and-calligraphic-works image.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]When this invention inputs a document into a document reader or a document filing device, it detects inclination of an input sentence document, and it relates to the document image detected inclination method to amend.
[0002]
[Description of the Prior Art]Generally, in a document reader, if inclination of an input sentence document is detected and amended, reading of the character written in structure understanding and input sentence documents, such as a layout of an input sentence document, will become easy compared with the case where inclination is not amended.
[0003]When detecting inclination of an input sentence document, since standards, such as a ruled line, do not always exist in an input sentence document, generally it is necessary to detect and amend inclination of a character string. Conventionally, as a method of detecting inclination of a character string, as shown, for example in "the space component extraction method using format specification information" (the Institute of Electronics, Information and Communication Engineers, the paper magazines D and vol, J66-D, No.1, PP 111-118, 1983), The marginal distribution of a black pixel part is searched for from two or more angular orientation from the whole document, and the method of searching for the angle of the direction it becomes acute [distribution] most [direction] is proposed. However, it was easy to receive the adverse effect by the figure, the photograph, a noise, etc. in this method, and there was a problem to say that cost

started processing time. In addition, for example, as shown in "on the other hand being a formula for the inclination correction of a document image" (the Institute of Electronics, Information and Communication Engineers, the paper magazines D and vol, J69-D, No.11, PP 1833-1834, 1986), The method with which the marginal distribution about the base of a bounding rectangle extracts the direction which becomes sharp, and detects inclination of a document image is proposed to the black formation part rectangle for which it asked by performing a contour extraction process to the whole input sentence document. However, in this method, there was a problem that the specific gravity of the contour extraction process in the whole processing was large, and the bounding rectangle of a black connected component could not be extracted by practical processing time.

[0004]

[Problem(s) to be Solved by the Invention]Thus, in a conventional document image detected inclination method and device, there was a fault of being easy to be damaged by the figure, the photograph, a noise, etc., and there was a problem that cost started about processing time further.

[0005]There is a place which it was made in order that this invention might solve such conventional SUBJECT, and is made into that purpose in providing the document image detected inclination method which can detect inclination of a document image correctly efficiently, even if the figure, the photograph, the noise, etc. are contained in the input sentence paintings-and-calligraphic-works image.

[0006]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, this invention is characterized by comprising the following:

A means to generate a picture which united a black pixel which approaches by changing into a black pixel a white picture element below a length delta pixel which was level or was inserted into a black pixel in for [vertical] either or both directions in a document image quantized by binary.

A means to extract i pieces x j local domains which divide a picture which united said approaching black pixel into n pieces x m mesh, and calculate the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element in each mesh and where the sum increases most which continued.

A portion which is level, or compresses image data for every scanning line of one of vertical, or both directions, and is managed in said local domain.

A means to detect inclination of an input sentence document by extracting complexity to two or more angular orientation to said local domain or said whole input sentence paintings-and-calligraphic-works image, and detecting an angle of a direction whose complexity is further the largest, A means to detect the detailed degree of angle of inclination of an input sentence document from three complexity of an angle of the degree of angle of inclination obtained with the arbitrary degrees of angular-resolution sigma, and the degree of order **sigma by angular resolution smaller than sigma.

[0007]A means to presume inclination of an input sentence paintings-and-calligraphic-works image by extracting complexity in two or more directions to a local domain or the whole input sentence paintings-and-calligraphic-works image, and detecting an angle of a direction whose complexity is further the largest, From a horizontal axis or a vertical axis, it is applied in a fixed range of the degree of **lambda, and angle detection may be performed in what kind of accuracy in this range. In a means to detect the above-mentioned inclination, hierarchical angle detection

of performing angle detection in near the angle which performs angle detection at the rough given degree of angular-resolution alpha, and has the largest complexity in it with the degree still smaller than the degree of alpha of angular-resolution sigma may be performed. After detecting inclination of an input sentence document by coarse angular resolution, it may be made to detect an angle of inclination of an input sentence document in desired accuracy by repeating successively performing detected inclination for near [the] an angle-of-inclination degree in still finer accuracy.

[0008]

[Function]Since inclination of a document image is detected when an input sentence document is scanned to two or more angular orientation, the complexity of each direction is extracted in the document image detected inclination method by this invention and complexity searches for the angle of the largest direction, Inclination of a document image can be detected without the influence by the small figure, photograph, and noise part of complexity winning popularity compared with a character string part.

[0009]Since the character string which is a part of input sentence document extracts the local domain which occupies most and performs detected inclination to the portion, inclination of an input sentence document is detectable by practical processing time.

[0010]

[Example]Hereafter, the example of this invention is described based on a drawing. Drawing 1 is a block diagram for explaining the document detected inclination method of this invention. The procedure of the document detected inclination method of this invention is outlined first.

[0011]In [after binary-izing an input sentence paintings-and-calligraphic-works image in the binarization processing part 2 to the document image inputted from the image input part 1 which comprises picture input devices, such as an image scanner,] either level at the black pixel fusion processing part 3 or a perpendicular direction and both directions, The black pixel which approaches by changing into a black pixel the white picture element below the length delta pixel inserted into a black pixel is united, and the picture Is which reduced the number of the black connection pixels contained in the whole document image is generated. Subsequently, the subregion where complexity is the largest is extracted as local domain La among the pictures generated in said black pixel fusion processing part 3 by the local domain extraction part 4. This local domain La can be regarded as most being occupied by the character string. The data management part 5 compresses and manages the picture included in local domain La extracted by the local domain extraction part 4 for the purpose of subsequent processing being performed efficiently. In the detected inclination part 6, inclination of an input sentence paintings-and-calligraphic-works image is detected using the data managed by the data management part 5. And it is judged whether inclination of an input sentence document is amended by the judgment part 7 to the degree of angle of inclination detected in the detected inclination part 6. Binarization processing carried out in the binarization processing part 2 among these may be realized by publicly known various techniques now. When the scanner etc. which have a binarization processing function are used as an image input part, the binarization processing part 2 is omitted. Hereafter, operation by each component part is explained in full detail.

[0012]In the black pixel fusion processing part 3, the number of the black connection pixel contained in an input sentence in the letter considering two or more black connection pixels (black pixel which follows a certain direction) close to a horizontal direction, a perpendicular direction, or its both directions as one black connection pixel is reduced. The purposes of this processing are that a throughput is reduced when extracting complexity in the detected

inclination part 6, and to extract neither a noise part nor a photographic part accidentally, when extracting subregion in the local domain extraction part 4. It is shorter than below a certain length delta pixel, and, specifically, realizes by changing into a black pixel all the white picture elements inserted into the black pixel. At this time, how to choose the value delta becomes a problem. In the detected inclination part 6, since inclination of an input sentence document is detected by extracting the complexity of a picture, the complexity extracted since the stroke and characters of a character which are contained in an input sentence document will unite if large delta is taken here will be that meaningless. Therefore, a stroke or characters of a character do not unite delta, but it is taken as a small value to such an extent that the number of the black connection pixels contained in sesame salt-like a fine noise part, a blurred photographic part, etc. changes few. If this processing is carried out, since complexity, such as a noise, a figure, and a photograph, will become small, the complexity of a string area portion becomes the highest among an input document. The picture acquired by black pixel fusion processing is set to Is.

[0013]In the local domain extraction part 4, local domain La which serves as a processing object of the detected inclination part 6 from the picture Is acquired by the black pixel fusion processing part 3 is extracted. In the detected inclination part 6, since inclination of an input sentence document is presumed by detecting inclination of the character string contained in the picture of a processing object, as for the local domain extracted by this local domain extraction part 4, most needs to be occupied by the character string. Detection of local domain La is realized by extracting the local domain where complexity is the largest in the picture Is. The extraction method of a concrete local domain is as follows, for example.

[0014]The picture Is is divided into m pieces x n mesh as first shown in drawing 2. Subsequently, the number of times which is level or changes from the white picture element in one scanning line of each of vertical to a black pixel or a white picture element from a black pixel is counted for every mesh, and let the number be the complexity of each mesh. And the sum of complexity extracts i pieces x j continuous local domain La (refer to drawing 3) which become the highest.

[0015]This extraction method may be realized, for example by the following approximate methods. That is, the complexity of the mesh contained there for every n horizontally long banded regions like drawing 4 is added, and j continuous banded regions (equivalent to the field s1 in drawing 4) where complexity becomes large most are extracted from n banded regions. The rate of the field s1 is perpendicularly carried out to m pieces for the time being still like drawing 5, a long banded region is built perpendicularly, the complexity of the mesh contained in each banded region is added, and i continuous banded regions (equivalent to the field s2 in drawing 5) where complexity becomes large most are extracted from m banded regions. Although the field s2 is not necessarily the most complicated field by input sentence letter, trouble does not have it about performing detected inclination processing in this field.

[0016]In the data management part 5, the image data contained in local domain La is compressed and managed for every [horizontally or] one scanning line of one of vertical, or both directions. This aims at raising processing efficiency, when extracting complexity in the detected inclination part 6. For example, the method shown below as a managing system of the image data contained in local domain La may be adopted.

[0017]<Data control method 1>: Express the image data in a local domain as a row of level or the run length numerals shown in drawing 6 in one of vertical, or both directions. <Data control method 2>: Horizontal or manage the head coordinate (center coordinates may be sufficient) of the black pixel which continues for every scanning line in a perpendicular direction. That it must

be careful at this time needs to normalize the head coordinate of each black pixel with the coordinate value of the left side of a local domain (that is, the coordinate value of the left side of a local domain is lengthened from the coordinate value of each black pixel). And the above data is managed and it applies to future processings.

[0018]In the detected inclination part 6, inclination of an input sentence document is detected from the compressed data which is managed by the data management part 5. If processing efficiency is not taken into consideration, the part image of the same position as La in the binary format image Ib of said inputted image or the binary format image Ib other than local domain La extracted from the picture Is and the same size may be used as an object image of detected inclination processing. Detected inclination processing performed in the detected inclination part 6 is realized by detecting the direction of the character string in an object domain, i.e., inclination. In this case, the direction of a character string (level or perpendicular direction) is premised on being known beforehand. Inclination of a character string asks for complexity within the limits of the degree of **lambda for two or more directions of every by a certain angular resolution sigma from either a horizontal axis or a vertical axis, and is detected by supposing that it is an angle with the largest complexity an angle of inclination of an input sentence document. This method uses the character in which the complexity in each scanning line serves as the maximum, when inclination and the scanning direction of a character string are in agreement.

[0019]Although it is in the definition of complexity variously, the complexity of a certain field is defined as "the value which calculated the value in which the number of times which changes from a black pixel or a black pixel to a white picture element carried out the square from the white picture element contained there for every scanning line, and added it in the whole field" here, for example. The above "number of times which changes from a white picture element to a black pixel or a white picture element from a black pixel" in the definition of this complexity can be interpreted as the number of a black connection pixel, when applying, for example to said data control method 1 and the data control method 2.

[0020]Although various methods can be considered also to the searching method of the angle of the scanning direction where complexity serves as the maximum, complexity is first extracted to every angular resolution sigma fixed as the example here, and the detected inclination method which detects an angle with the maximum complexity is explained. However, as for lambda, it is desirable that it is a value which can be divided among sigma.

[0021]<Inclination detection method 1>: What is necessary is just to detect inclination from a horizontal axis (0 times) in the range within the degree of **lambda, when an input sentence document restricts to lateral writing like drawing 3. The concrete processing which asks for the degree theta of angle of inclination of an input sentence document from local domain La of drawing 3 consists of the following four steps, for example. Here, it is considered as theta = -lambda** as an initial value.

[0022]Step 1: Scan local domain La in the angle theta direction, and calculate value:LINE COMPLEXITY (it is considered as the complexity of each scanning line) which carried out the square of "the number of times which changes from a white picture element to a black pixel or a white picture element from a black pixel" for every scanning line.

[0023]Step 2: total of the above "complexity:LINE COMPLEXITY which is every scanning line" in the whole local domain: Let this be the complexity of local domain La at the time of the angle theta in quest of ALL LINE COMPLEXITY.

[0024]Step 3: theta is increased by the degree of sigma and Step 1 and Step 2 are performed.

However, theta needs to be filling -lambda**<=theta<=+lambda**. Here, it is good also as sigma=1 and lambda= 32, for example.
[0025]Step 4: complexity of +one 2 lambda/sigma for which it asked at Step 3 (65 complexity can be found when referred to as sigma=1 and lambda= 32) : The angle theta with largest complexity:MAX COMPLEXITY in ALL LINE COMPLEXITY is detected, Let the angle theta be the degree of angle of inclination of an input sentence document.
[0026]It may ask for the continuous black pixel contained in the arbitrary scanning lines of arbitrary angles in processing of Step 1 in the above processing, for example approximately as follows. Namely, when the picture included in local domain La is managed with said data control method 2 (how to manage the head coordinate and the number of the black pixel which continues in every horizontal scanning line), The black connection pixel whose head coordinate managed with the j-th scanning line from the top in local domain La is x will be contained in the y-th scanning line that can be found by the following (1) formula at the time of the angle theta.
[0027]
y = j+tantheta x x -- (1) How complexity next searches for the angle used as the maximum efficiently is shown below. This method reduces the processing frequency of "Step 1 and Step 2" which requires processing time most in the above-mentioned inclination detection method 1. That is, after searching to some extent coarse angular-resolution alpha** for the maximum complexity, it is a method which considers the angle which searches angular-resolution sigma** smaller than alpha** for the maximum complexity further in near an angle with that maximum complexity, and has the maximum complexity in this case as inclination of an input sentence document. As for lambda, at this time, it is desirable that it is a value which can be divided among both alpha and sigma.
[0028]<Inclination detection method 2>: this gentleman method changes Step 3 and Step 4 as follows in the above <inclination detection method 1> (it is considered as step 3' and step 4', respectively), and is realized by adding Steps 5 and 6 further. Here, since Step 1 and Step 2 are the same as that of the inclination detection method 1, explanation is omitted.
[0029]Step 3': theta is increased by the degree of alpha and Step 1 and Step 2 are performed. However, it is necessary to fill -lambda**<=theta<=+lambda**. It is good also as alpha= 4 and lambda= 32 here.
[0030]step 4': -- complexity [of +one 2 lambda/alpha for which it asked at Step 3]: -- the inside of ALL LINE COMPLEXITY1 -- the maximum -- The angle theta 1 with complexity:MAX COMPLEXITY1 [large] is detected.
[0031]Step 5: Set angular resolution to sigma near the angle theta 1 detected by step 4' (for example, theta1 - alpha/2 <= theta <=theta1 + alpha/2 of ranges), and perform Steps 1-2. Here, it is good also as sigma=1, for example.
[0032]Step 6: alpha+1 complexity for which it asked at Step 5: The angle theta 2 with complexity:MAX COMPLEXITY2 [largest] in ALL LINE COMPLEXITY2 is detected, and let the angle theta 2 be the degree of angle of inclination of an input sentence document.
[0033]For example, when the above-mentioned inclination detection method 2 is applied as alpha= 4 and sigma=1, the processing frequency of Steps 1 and 2 will be 22 times, its throughput decreases compared with said inclination detection method 1 (this gentleman method 65 times), and improvement in the speed of it is attained.
[0034]In the judgment part 7, it is judged whether based on the value theta of the degree of angle of inclination of the input sentence document detected in said detected inclination part 6, inclination of said input sentence paintings-and-calligraphic-works image is amended. Here, in

consideration of the document structure analysis and understanding capability of a document reader which are set, for example as the latter part, or character reading capability, the judgment about implementation of inclination of an input part document is performed by the following methods. That is, a document reader performs the following judgments by the following (2) types, when it turns out beforehand that it does not interfere with reading of a character etc., if inclination of an input sentence document is less than **nu**.

[0035]

- In the case of nu <= theta <= nu : Inclination correction processing is not carried out. When other : Inclination correction processing is carried out. -- The procedure of the document image detected inclination method of this invention is ended by more than (2).

[0036]In applying the above-mentioned document image detected inclination method to a document reader, it supplies further the degree theta of angle of inclination of the input sentence document detected by the above-mentioned document image detected inclination method to the document image inclination correction part 8. In the document image inclination correction part 8, an input sentence paintings-and-calligraphic-works image is rotated at the angle theta detected in the document image detected inclination part, inclination of an input sentence paintings-and-calligraphic-works image is amended, and the picture after amendment is supplied to the document reading part 10. As a result, in the document reading part 10, the input sentence paintings-and-calligraphic-works image which always does not have inclination will be inputted, and stable reading processing is realized.

[0037]The <2nd example> In the 1st example mentioned above, we decided to detect inclination of an input sentence document by detecting the direction of the character string contained in a local domain. At this time, as a method of detecting the angular orientation of a character string, it scanned to two or more angular orientation, and how to detect an angle with the largest complexity was explained in the range of the degree of **lambda from either the horizontal axis or the vertical axis. This method supposes that the direction of a character string of an input sentence document must be known. That is, if the direction of a character string of the input sentence document was level (lateral writing), the detection range of the degree of angle of inclination was made into the degree of **lambda from the horizontal axis (0 times), and if the direction of a character string is vertical (vertical writing), inclination of an input sentence document will be detected for the detection range of the degree of angle of inclination from the vertical axis (90 degrees) as a degree of **lambda. In this method, when the direction of a character string of an input sentence document is strange, there is no telling into which the detection range of complexity should be made. Then, it explains, referring to drawing 7 for the <detected inclination method 3> which is a method which can detect inclination of an input sentence document, when the direction of a character string is strange. Here, a different portion from the detected inclination method described in the 1st example is described.

[0038]<Detected-inclination method 3>: Since the processing from the processing in the binarization processing part 2 in drawing 7 to the local domain extraction part 4 is the same as that of Example 1, omit explanation.

[0039]In the detected inclination method 3, the data management part 5 is changed as follows. That is, although horizontal or data is managed in the vertical direction of either in the 1st example, data is managed in both directions here. After managing data for every horizontal scanning line in the horizontal data management part 11 with either one of the above <data management method 1> or the above <data management method 2> (the data obtained at this time is made into horizontal local data), Furthermore in the perpendicular direction data

management part 12, also perpendicularly, data is managed for every scanning line (the data obtained at this time is set to vertical localdata).
[0040]In the horizontal detected inclination part 13, first, From Step 1 of said detected inclination method 2 to the step 5 is applied from Step 1 of said detected inclination method 1 to horizontal local data extracted from said local domain La to Step 3 in the range of a horizontal axis (0 times) to the degree of **lambda, Complexity of two or more angular orientation: Extract horizontal complexity. It ranks second, In the perpendicular direction detected inclination part 14, from a vertical axis (90 degrees), in the range of the degree of **lambda from Step 1 of the above <detected inclination method 1> to Step 3. Or from Step 1 of the above <detected inclination method 2> to the step 5 is applied to vertical local data extracted from said local domain La, and complexity:vertical complexity of two or more angular orientation is extracted.
[0041]And it determines whether to compare horizontal complexity with vertical complexity in the inclination direction discrimination section 15, and to detect inclination of an input sentence document from distribution of which complexity. This method may be realized by the discriminating method shown below, for example. Here the maximum in horizontal complexity max horizontalcomplexity, The minimum min horizontal complexity, (Angle with max horizontal complexity) The sum of two horizontal complexity of the degree of **sigma and max horizontal complexity is made into sumhorizontal complexity, The maximum in vertical complexity max verticalcomplexity, The minimum min vertical complexity, (Angle with max vertical complexity) The sum of two vertical complexity of the degree of **sigma and max vertical complexity is made into sum vertical complexity.
[0042]Let an angle with max vertical complexity be an angle of inclination of an input sentence document at the time of <discriminating method 1>:max horizontal complexity < max vertical complexity+th1.
[0043]Let an angle with max horizontal complexity be an angle of inclination of an input sentence document at the time of max horizontal complexity+th1 > max vertical complexity.
[0044]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible). Here, it is th1. : It is considered as a threshold.
[0045]<Discriminating method 2> : (max horizontal.) At the time of complexity - min horizontal complexity<(max vertical complexity - min vertical complexity)+th2. Let an angle with max vertical complexity be an angle of inclination of an input sentence document.
[0046]At the time of (max horizontal complexity - min horizontal complexity)+th2 > (max vertical complexity - min vertical complexity). Let an angle with max horizontalcomplexity be an angle of inclination of an input sentence document.
[0047]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible). Here, it is th2. : It is considered as a threshold.
[0048]Let an angle with max vertical complexity be an angle of inclination of an input sentence document at the time of <discriminating method 3>:sum horizontal complexity < sum vertical complexity+th3.
[0049]Let an angle with max horizontal complexity be an angle of inclination of an input sentence document at the time of sum horizontal complexity+th3 > sum vertical complexity.
[0050]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible).
[0051]<Discriminating method 4>:if (distinction of the discriminating method 1 is not impossible) The result of the discriminating method 1 is adopted.
[0052]else if (distinction of the discriminating method 1 is impossible)

if (distinction of the discriminating method 2 is not impossible) The result of the discriminating method 2 is adopted.
[0053]else if (distinction of the discriminating method 2 is impossible)
if (distinction of the discriminating method 3 is not impossible) The result of the discriminating method 3 is adopted.
else if (distinction of the discriminating method 3 is impossible)
The angle of inclination of an input sentence document is made into detection impossible (distinction is impossible).
[0054]Since the decision processing performed by the judgment part 7 is the same as that of the 1st example, explanation is omitted. If the above processing procedure is used, before detecting inclination of an input sentence document, even if the direction of a character string is strange, inclination of an input sentence document is correctly detectable beforehand.
[0055]As a result of applying the above processing, in making an angle with max horizontal complexity into the angle of inclination of an input sentence document, In making into the angle of inclination of an input sentence document the angle which makes horizontal the direction of a character string of an input sentence document, and has max vertical complexity, The direction of a character string of an input sentence document is distinguished, and it may be made to supply the discriminated result to a latter document reader by making perpendicular the direction of a character string of an input sentence document. However, the direction of the character string written in the input sentence document in this case is horizontal, or is restricted to one of vertical.
[0056]It is the method explained in the 1st example of <the 3rd example>, and is angular resolution, for example 0.1 in considering it as a degree and detecting the degree of angle of inclination of an input sentence document, For example, it is near the angle of inclination theta 1 of an input sentence document in case angular resolution is 1 time (for example, theta1 -0.5 <= theta <= theta 1 the range of +0.5), and is angular resolution further 0.1 It must be considered as a degree and the detailed degree of angle of inclination of an input sentence document must be detected. Therefore, the method explained in the 1st example is desired angular resolution 0.1 When below a degree carries out, processing time will start (for example, in <the detected inclination method 2>, Step 1 and Step 2 must be applied further too many 11 times). So, it is 0.1 here. The <detected inclination method 4> which is the method of performing detected inclination processing at high speed by the angular resolution of a degree is explained. After <the detected inclination method 4> detects the degree theta 1 of angle of inclination of an input sentence document by the angular resolution of 1 time with the method explained in the 1st example, Complexity of theta 1: max complexity and theta 1 Complexity of -1 ": before complexity and theta 1 Approximation reasoning or fuzzy reasoning from three complexity of the +1 degree complexity aftercomplexity. The degree theta 2 of angle of inclination in case it uses and angular resolution is 0.1 degree or less is theta 1. -0.5 It is theta 1 above. +0.5 It is presumed which angle of the following ranges it is.
[0057]It is not necessarily guaranteed that values, such as max complexity and before complexity which were obtained in the 1st detected inclination part, and after complexity, are respectively reliable exact values. Therefore, by this method, it is suitable to such an inaccurate value, and the purpose of processing information efficiently with an ambiguous form and obtaining an appropriate result is carried out. The angle detection algorithm containing the above ambiguities shown by this method is "if. It consists of procedure which interprets the reasoning and the inference result by two or more rules of the form of antecedent part then consequent part", and

presumes the degree of angle of inclination. Hereafter, <the detected inclination method 4> is explained according to the block diagram of drawing 8.
[0058]<Detected-inclination method 4>: The processing set and carried out by the 1st detected inclination part 16 from the binarization processing part 2 of the block diagram shown in drawing 8 is based on the method explained in the 1st example. However, the 1st detected inclination part 16 makes angular resolution sigma=1 degree, and detects the degree of angle of inclination of an input sentence document.
[0059]At the 2nd detected inclination part 17, it is max complexity, before complexity, after complexity and theta 1, and theta 1 from the 1st detected inclination part 16. -1 and theta 1 +1 is received. And it is angular resolution by using three rules including the ambiguous variable shown below as opposed to these six values 0.1 The degree of angle of inclination of an input sentence document when it is considered as a degree is detected. Here, the larger one is set to second complexity among before complexity and after complexity.
[0060]Rule 1: If the difference of before complexity and after complexity is small, theta 2 is near theta 1.
[0061]Rule 2: If the difference of second complexity and max complexity is small, theta 2 is in the middle of an angle with theta 1 and second complexity.
[0062]Rule 3: If the difference of second complexity and max complexity is large, theta 2 is near theta 1.
[0063]The ambiguous variable of the underline part in the three above-mentioned rules expresses the degree about the truth of the proposition of the antecedent part included all over the Ruhr, and a consequent part with a value with the section [0, 1].
[0064]In actual processing, the above-mentioned rule is expressed as follows.
[0065]
Rule 1: If diff1 is A1 then theta2 is B1.
Rule 2: If diff2 is A2 then theta2 is B-2.
Rule 3: If diff2 is A3 then theta2 is B1.
diff1 =|before complexity. - after complexity | A1 = 1- diff1 x 10 / max complecity -- (3) (however) diff2 = max complecity - second complecity -- (4) It is referred to as A1 =0 at the time of A1 <0. -- A2 = 1 (5) - diff1 x 10 / max complecity (however, at the time of A2 <0.) it is referred to as A2 =0 -- 1 (at the time of theta1-0.5 <= theta<=theta 1.) -- A3 = 1 - A2 -- B1 = 2xtheta - 2xtheta1 + (7) (6) -2xtheta+ 2xtheta1 + 1 (at the time of theta1 < theta<=theta 1+0.5) -- (8) Angle with B-2 = if second complexity is theta1 -1 then 2xtheta - 2xtheta1 + 2 (at the time of theta1-1 <= theta<=theta 1-0.5)
-2xtheta+ 2xtheta1 (at the time of theta1-0.5 < theta<=theta 1)
-- (9) Angle with else if second complexity is theta1 Angle with +1 else if second complexity is theta1 +1 then 2xtheta - 2xtheta1 (at the time of theta1 <= theta<=theta 1+0.5)
-2xtheta+ 2xtheta1 + 2 (at the time of theta1+0.5 < theta<=theta 1+1)
-- (10) Here, |k| is taken as the absolute value of k. A1 is a membership function expressing "the difference of before complexity and after complexity is small", When it comes to A1 <0, it comes, and is referred to as A1 =0, and A2 is a membership function expressing "the difference of second complexity and max complexity is small", When it comes to A2 <0, it comes, and is referred to as A2 =0, and A3 is a membership function expressing "the difference of second complexity and max complexity is large." B1 is a membership function (considerable in [B1] drawing 9) expressing "near theta 1", and B-2 is a membership function (equivalent to B-2 in drawing 9) expressing "the middle of an angle with theta 1 and second complexity."

[0066]<The detected inclination method 4> performs reasoning for every rule first, and obtains an inference result. The inference result in each rule expresses the degree (namely, membership function) of the truth of the consequent part of each rule, and then unifies this (the membership function obtained by integration is made into B'). And the inference result integrated is interpreted by a means to search for the center of gravity y of membership function B', and it is an interpretation result 0.1 It is considered as the degree of angle of inclination of the input sentence document detected by the angular resolution of the degree. Below, a concrete calculation method is explained.
[0067]Step 1: Calculation of the goodness of fit of the antecedent part of each rule, and selection of an application rule.
[0068]In the rule 1, the value (it is considered as the goodness of fit of the antecedent part of the rule 1) of A1 is calculated, the value (it is considered as the goodness of fit of the antecedent part of the rule 2) of A2 is calculated in the rule 2, and the value (it is considered as the goodness of fit of the antecedent part of the rule 3) of A3 is calculated in the rule 3. Here, at the time of A1 >=A3, it supposes that the rule 3 is not applied and suppose that the rule 3 is applied as the rule 1 at the time of A1 < A3 (only the rule 1 and the rule 2 will be used in the following calculations).
[0069]Step 2: Calculation and integration of the inference result of each rule.
[0070]First, the following (11) types are asked for inference result B1' of the rule 1 with the application of the goodness of fit A1 of the rule 1.
[0071]
B1'= A1 lambda B1 -- (11) Specifically, this is cutting the membership function B1 by A1 like drawing 10. As a result, B1' becomes a membership function like drawing 10.
[0072]Next, the following (12) types are asked for inference result B-2' of the rule 2 with the application of the goodness of fit A2 of the rule 2.
[0073]
B-2'= A2 lambda B-2 -- (12) Specifically, this is cutting membership function B-2 by A2 like drawing 11. As a result, B-2' becomes a membership function like drawing 11.
[0074]And B1' and B-2' are unified and membership function B' like drawing 12 is built.
[0075]Step 3: Presumption of the degree of angle of inclination by the interpretation of an inference result.
[0076]An inference result is interpreted by searching for by the following (13) types, the weighting average y, i.e., "the center of gravity of membership function B'", by the goodness of fit of the inference result in each rule. And let the center of gravity y be the degree of angle of inclination of an input sentence document.
[0077]
y = / (integralB'(theta) thetadtheta) (integralB'(theta) dtheta) -- (13) Change of the contents and the number is possible for the rule used above <the detected inclination method 4>. Modification of the membership function used with each rule is also possible, and may change if needed. It is also possible to use the learned neural network instead of said membership function furthermore. In addition, the operation which derives an inference result in each rule can also use known various methods.
[0078]In the 1st example of <the 4th example>, when applying this invention to a document reader, an input sentence document is rotated using the degree of angle of inclination of the input sentence document detected by the detected inclination method by this invention, and it is supposed that the input sentence paintings-and-calligraphic-works image which amended inclination is supplied to a document reader etc. In this case, detected inclination processing is

detected in desired accuracy, and the picture further changed by inclination correction processing may add as follows the function to check whether it is amended within desired accuracy (for example, 0 degree**0.5 degree). The processing procedure which realizes the above-mentioned acknowledgement function is explained using drawing 13.

[0079]The black pixel fusion processing carried out in the input sentence paintings-and-calligraphic-works image detected inclination part 8 in drawing 13, local domain extracting processing, data management processing, and decision processing are the same as that of what was described in Example 1, Since detected inclination processing is the same as processing by one of methods among the above <detected inclination mode of processing 1-4>, explanation is omitted. In the following document image rotation processing part 18, input sentence paintings-and-calligraphic-works rotation of image processing is carried out by methods, such as "a high velocity revolution method of the picture by the parallel translation of coordinates" (******C, 105, 3, pp.61-68-1985), using the angle of inclination of the input sentence document detected by the above-mentioned detected inclination processing. And the above-mentioned detected inclination processing is again performed to said rotated picture after that, and the inclination is detected. In the confirming processing part 19, if the degree of angle of inclination of said rotated picture is an angle (for example, 0 degree**0.5 less than degree) of the request in a desired error span, Said rotated input sentence paintings-and-calligraphic-works image is supplied to a latter document reader, and if the degree of angle of inclination of said rotated picture is not an angle of the request in a desired error span, reinput of an input sentence document will be demanded from a user.

[0080]The above processing procedure may be carried out to procedure like drawing 14. That is, processing procedure of drawing 14 is repeatedly performed until the degree of angle of inclination of the picture turning around the above-mentioned inclination rotating process, the above-mentioned detected inclination processing, and the above-mentioned confirming processing turns into an angle of the request in a desired error span. If the degree of angle of inclination of the rotated picture does not turn into an angle of the request in a desired error span even if it repeats h times at this time, he is trying to demand reinput of an input sentence document from a user.

[0081]In the range which does not deviate from the gist, it can change variously, and can realize, this invention can be made into a various application, and it can have it.

[0082]

[Effect of the Invention]As explained above, since inclination of an input sentence document is detected by investigating the complexity of an input sentence document, by the document image detected inclination method of this invention, complexity can realize detected inclination processing stabilized without receiving the influence by comparatively small figure, photograph, noise, etc. to a character string part.

[0083]In the document image detected inclination method of this invention, since the character string extracted automatically performs detected inclination processing efficiently hierarchical to the local domain which occupies most, the effect that cost performance is improved remarkably is acquired.

TECHNICAL FIELD

[Industrial Application]When this invention inputs a document into a document reader or a document filing device, it detects inclination of an input sentence document, and it relates to the document image detected inclination method to amend.

PRIOR ART

[Description of the Prior Art]Generally, in a document reader, if inclination of an input sentence document is detected and amended, reading of the character written in structure understanding and input sentence documents, such as a layout of an input sentence document, will become easy compared with the case where inclination is not amended.
[0003]When detecting inclination of an input sentence document, since standards, such as a ruled line, do not always exist in an input sentence document, generally it is necessary to detect and amend inclination of a character string. Conventionally, as a method of detecting inclination of a character string, as shown, for example in "the space component extraction method using format specification information" (the Institute of Electronics, Information and Communication Engineers, the paper magazines D and vol, J66-D, No.1, PP 111-118, 1983), The marginal distribution of a black pixel part is searched for from two or more angular orientation from the whole document, and the method of searching for the angle of the direction it becomes acute [distribution] most [direction] is proposed. However, it was easy to receive the adverse effect by the figure, the photograph, a noise, etc. in this method, and there was a problem to say that cost started processing time. In addition, for example, as shown in "on the other hand being a formula for the inclination correction of a document image" (the Institute of Electronics, Information and Communication Engineers, the paper magazines D and vol, J69-D, No.11, PP 1833-1834, 1986), The method with which the marginal distribution about the base of a bounding rectangle extracts the direction which becomes sharp, and detects inclination of a document image is proposed to the black formation part rectangle for which it asked by performing a contour extraction process to the whole input sentence document. However, in this method, there was a problem that the specific gravity of the contour extraction process in the whole processing was large, and the bounding rectangle of a black connected component could not be extracted by practical processing time.

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, since inclination of an input sentence document is detected by investigating the complexity of an input sentence document, by the document image detected inclination method of this invention, complexity can realize detected inclination processing stabilized without receiving the influence by comparatively small figure, photograph, noise, etc. to a character string part.
[0083]In the document image detected inclination method of this invention, since the character string extracted automatically performs detected inclination processing efficiently hierarchical to the local domain which occupies most, the effect that cost performance is improved remarkably is acquired.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]Thus, in a conventional document image detected inclination method and device, there was a fault of being easy to be damaged by the figure, the photograph, a noise, etc., and there was a problem that cost started about processing time further.
[0005]There is a place which it was made in order that this invention might solve such conventional SUBJECT, and is made into that purpose in providing the document image detected inclination method which can detect inclination of a document image correctly efficiently, even if the figure, the photograph, the noise, etc. are contained in the input sentence paintings-and-calligraphic-works image.

MEANS

[Means for Solving the Problem]In order to attain the above-mentioned purpose, this invention is characterized by comprising the following:
A means to generate a picture which united a black pixel which approaches by changing into a black pixel a white picture element below a length delta pixel which was level or was inserted into a black pixel in for [vertical] either or both directions in a document image quantized by binary.
A means to extract i pieces x j local domains which divide a picture which united said approaching black pixel into n pieces x m mesh, and calculate the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element in each mesh and where the sum increases most which continued.
A portion which is level, or compresses image data for every scanning line of one of vertical, or both directions, and is managed in said local domain.
A means to detect inclination of an input sentence document by extracting complexity to two or more angular orientation to said local domain or said whole input sentence paintings-and-calligraphic-works image, and detecting an angle of a direction whose complexity is further the largest, A means to detect the detailed degree of angle of inclination of an input sentence document from three complexity of an angle of the degree of angle of inclination obtained with the arbitrary degrees of angular-resolution sigma, and the degree of order **sigma by angular resolution smaller than sigma.

[0007]A means to presume inclination of an input sentence paintings-and-calligraphic-works image by extracting complexity in two or more directions to a local domain or the whole input sentence paintings-and-calligraphic-works image, and detecting an angle of a direction whose complexity is further the largest, From a horizontal axis or a vertical axis, it is applied in a fixed range of the degree of **lambda, and angle detection may be performed in what kind of accuracy in this range. In a means to detect the above-mentioned inclination, hierarchical angle detection of performing angle detection in near the angle which performs angle detection at the rough given degree of angular-resolution alpha, and has the largest complexity in it with the degree still smaller than the degree of alpha of angular-resolution sigma may be performed. After detecting inclination of an input sentence document by coarse angular resolution, it may be made to detect an angle of inclination of an input sentence document in desired accuracy by repeating successively performing detected inclination for near [the] an angle-of-inclination degree in still finer accuracy.

OPERATION

[Function]Since inclination of a document image is detected when an input sentence document is scanned to two or more angular orientation, the complexity of each direction is extracted in the document image detected inclination method by this invention and complexity searches for the angle of the largest direction, Inclination of a document image can be detected without the influence by the small figure, photograph, and noise part of complexity winning popularity compared with a character string part.
[0009]Since the character string which is a part of input sentence document extracts the local domain which occupies most and performs detected inclination to the portion, inclination of an input sentence document is detectable by practical processing time.

EXAMPLE

[Example]Hereafter, the example of this invention is described based on a drawing. Drawing 1 is a block diagram for explaining the document detected inclination method of this invention. The procedure of the document detected inclination method of this invention is outlined first.
[0011]In [after binary-izing an input sentence paintings-and-calligraphic-works image in the binarization processing part 2 to the document image inputted from the image input part 1 which comprises picture input devices, such as an image scanner,] either level at the black pixel fusion processing part 3 or a perpendicular direction and both directions, The black pixel which approaches by changing into a black pixel the white picture element below the length delta pixel inserted into a black pixel is united, and the picture Is which reduced the number of the black connection pixels contained in the whole document image is generated. Subsequently, the subregion where complexity is the largest is extracted as local domain La among the pictures generated in said black pixel fusion processing part 3 by the local domain extraction part 4. This local domain La can be regarded as most being occupied by the character string. The data management part 5 compresses and manages the picture included in local domain La extracted by the local domain extraction part 4 for the purpose of subsequent processing being performed efficiently. In the detected inclination part 6, inclination of an input sentence paintings-and-calligraphic-works image is detected using the data managed by the data management part 5. And it is judged whether inclination of an input sentence document is amended by the judgment part 7 to the degree of angle of inclination detected in the detected inclination part 6. Binarization processing carried out in the binarization processing part 2 among these may be realized by publicly known various techniques now. When the scanner etc. which have a binarization processing function are used as an image input part, the binarization processing part 2 is omitted. Hereafter, operation by each component part is explained in full detail.
[0012]In the black pixel fusion processing part 3, the number of the black connection pixel contained in an input sentence in the letter considering two or more black connection pixels (black pixel which follows a certain direction) close to a horizontal direction, a perpendicular direction, or its both directions as one black connection pixel is reduced. The purposes of this processing are that a throughput is reduced when extracting complexity in the detected inclination part 6, and to extract neither a noise part nor a photographic part accidentally, when extracting subregion in the local domain extraction part 4. It is shorter than below a certain length delta pixel, and, specifically, realizes by changing into a black pixel all the white picture elements inserted into the black pixel. At this time, how to choose the value delta becomes a problem. In the detected inclination part 6, since inclination of an input sentence document is

detected by extracting the complexity of a picture, the complexity extracted since the stroke and characters of a character which are contained in an input sentence document will unite if large delta is taken here will be that meaningless. Therefore, a stroke or characters of a character do not unite delta, but it is taken as a small value to such an extent that the number of the black connection pixels contained in sesame salt-like a fine noise part, a blurred photographic part, etc. changes few. If this processing is carried out, since complexity, such as a noise, a figure, and a photograph, will become small, the complexity of a string area portion becomes the highest among an input document. The picture acquired by black pixel fusion processing is set to Is.

[0013]In the local domain extraction part 4, local domain La which serves as a processing object of the detected inclination part 6 from the picture Is acquired by the black pixel fusion processing part 3 is extracted. In the detected inclination part 6, since inclination of an input sentence document is presumed by detecting inclination of the character string contained in the picture of a processing object, as for the local domain extracted by this local domain extraction part 4, most needs to be occupied by the character string. Detection of local domain La is realized by extracting the local domain where complexity is the largest in the picture Is. The extraction method of a concrete local domain is as follows, for example.

[0014]The picture Is is divided into m pieces x n mesh as first shown in drawing 2. Subsequently, the number of times which is level or changes from the white picture element in one scanning line of each of vertical to a black pixel or a white picture element from a black pixel is counted for every mesh, and let the number be the complexity of each mesh. And the sum of complexity extracts i pieces x j continuous local domain La (refer to drawing 3) which become the highest.

[0015]This extraction method may be realized, for example by the following approximate methods. That is, the complexity of the mesh contained there for every n horizontally long banded regions like drawing 4 is added, and j continuous banded regions (equivalent to the field s1 in drawing 4) where complexity becomes large most are extracted from n banded regions. The rate of the field s1 is perpendicularly carried out to m pieces for the time being still like drawing 5, a long banded region is built perpendicularly, the complexity of the mesh contained in each banded region is added, and i continuous banded regions (equivalent to the field s2 in drawing 5) where complexity becomes large most are extracted from m banded regions. Although the field s2 is not necessarily the most complicated field by input sentence letter, trouble does not have it about performing detected inclination processing in this field.

[0016]In the data management part 5, the image data contained in local domain La is compressed and managed for every [horizontally or] one scanning line of one of vertical, or both directions. This aims at raising processing efficiency, when extracting complexity in the detected inclination part 6. For example, the method shown below as a managing system of the image data contained in local domain La may be adopted.

[0017]<Data control method 1>: Express the image data in a local domain as a row of level or the run length numerals shown in drawing 6 in one of vertical, or both directions. <Data control method 2>: Horizontal or manage the head coordinate (center coordinates may be sufficient) of the black pixel which continues for every scanning line in a perpendicular direction. That it must be careful at this time needs to normalize the head coordinate of each black pixel with the coordinate value of the left side of a local domain (that is, the coordinate value of the left side of a local domain is lengthened from the coordinate value of each black pixel). And the above data is managed and it applies to future processings.

[0018]In the detected inclination part 6, inclination of an input sentence document is detected

from the compressed data which is managed by the data management part 5. If processing efficiency is not taken into consideration, the part image of the same position as La in the binary format image Ib of said inputted image or the binary format image Ib other than local domain La extracted from the picture Is and the same size may be used as an object image of detected inclination processing. Detected inclination processing performed in the detected inclination part 6 is realized by detecting the direction of the character string in an object domain, i.e., inclination. In this case, the direction of a character string (level or perpendicular direction) is premised on being known beforehand. Inclination of a character string asks for complexity within the limits of the degree of **lambda for two or more directions of every by a certain angular resolution sigma from either a horizontal axis or a vertical axis, and is detected by supposing that it is an angle with the largest complexity an angle of inclination of an input sentence document. This method uses the character in which the complexity in each scanning line serves as the maximum, when inclination and the scanning direction of a character string are in agreement.

[0019]Although it is in the definition of complexity variously, the complexity of a certain field is defined as "the value which calculated the value in which the number of times which changes from a black pixel or a black pixel to a white picture element carried out the square from the white picture element contained there for every scanning line, and added it in the whole field" here, for example. The above "number of times which changes from a white picture element to a black pixel or a white picture element from a black pixel" in the definition of this complexity can be interpreted as the number of a black connection pixel, when applying, for example to said data control method 1 and the data control method 2.

[0020]Although various methods can be considered also to the searching method of the angle of the scanning direction where complexity serves as the maximum, complexity is first extracted to every angular resolution sigma fixed as the example here, and the detected inclination method which detects an angle with the maximum complexity is explained. However, as for lambda, it is desirable that it is a value which can be divided among sigma.

[0021]<Inclination detection method 1>: What is necessary is just to detect inclination from a horizontal axis (0 times) in the range within the degree of **lambda, when an input sentence document restricts to lateral writing like drawing 3. The concrete processing which asks for the degree theta of angle of inclination of an input sentence document from local domain La of drawing 3 consists of the following four steps, for example. Here, it is considered as theta = -lambda** as an initial value.

[0022]Step 1: Scan local domain La in the angle theta direction, and calculate value:LINE COMPLEXITY (it is considered as the complexity of each scanning line) which carried out the square of "the number of times which changes from a white picture element to a black pixel or a white picture element from a black pixel" for every scanning line.

[0023]Step 2: total of the above "complexity:LINE COMPLEXITY which is every scanning line" in the whole local domain: Let this be the complexity of local domain La at the time of the angle theta in quest of ALL LINE COMPLEXITY.

[0024]Step 3: theta is increased by the degree of sigma and Step 1 and Step 2 are performed. However, theta needs to be filling -lambda**<=theta<=+lambda**. Here, it is good also as sigma=1 and lambda= 32, for example.

[0025]Step 4: complexity of +one 2 lambda/sigma for which it asked at Step 3 (65 complexity can be found when referred to as sigma=1 and lambda= 32) : The angle theta with largest complexity:MAX COMPLEXITY in ALL LINE COMPLEXITY is detected, Let the angle theta

be the degree of angle of inclination of an input sentence document.
[0026]It may ask for the continuous black pixel contained in the arbitrary scanning lines of arbitrary angles in processing of Step 1 in the above processing, for example approximately as follows. Namely, when the picture included in local domain La is managed with said data control method 2 (how to manage the head coordinate and the number of the black pixel which continues in every horizontal scanning line), The black connection pixel whose head coordinate managed with the j-th scanning line from the top in local domain La is x will be contained in the y-th scanning line that can be found by the following (1) formula at the time of the angle theta.
[0027]
y = j+tantheta x x -- (1) How complexity next searches for the angle used as the maximum efficiently is shown below. This method reduces the processing frequency of "Step 1 and Step 2" which requires processing time most in the above-mentioned inclination detection method 1. That is, after searching to some extent coarse angular-resolution alpha** for the maximum complexity, it is a method which considers the angle which searches angular-resolution sigma** smaller than alpha** for the maximum complexity further in near an angle with that maximum complexity, and has the maximum complexity in this case as inclination of an input sentence document. As for lambda, at this time, it is desirable that it is a value which can be divided among both alpha and sigma.
[0028]<Inclination detection method 2>: this gentleman method changes Step 3 and Step 4 as follows in the above <inclination detection method 1> (it is considered as step 3' and step 4', respectively), and is realized by adding Steps 5 and 6 further. Here, since Step 1 and Step 2 are the same as that of the inclination detection method 1, explanation is omitted.
[0029]Step 3': theta is increased by the degree of alpha and Step 1 and Step 2 are performed. However, it is necessary to fill -lambda**<=theta<=+lambda**. It is good also as alpha= 4 and lambda= 32 here.
[0030]step 4': -- complexity [of +one 2 lambda/alpha for which it asked at Step 3]: -- the inside of ALL LINE COMPLEXITY1 -- the maximum -- The angle theta 1 with complexity:MAX COMPLEXITY1 [large] is detected.
[0031]Step 5: Set angular resolution to sigma near the angle theta 1 detected by step 4' (for example, theta1 - alpha/2 <= theta <=theta1 + alpha/2 of ranges), and perform Steps 1-2. Here, it is good also as sigma=1, for example.
[0032]Step 6: alpha+1 complexity for which it asked at Step 5: The angle theta 2 with complexity:MAX COMPLEXITY2 [largest] in ALL LINE COMPLEXITY2 is detected, and let the angle theta 2 be the degree of angle of inclination of an input sentence document.
[0033]For example, when the above-mentioned inclination detection method 2 is applied as alpha= 4 and sigma=1, the processing frequency of Steps 1 and 2 will be 22 times, its throughput decreases compared with said inclination detection method 1 (this gentleman method 65 times), and improvement in the speed of it is attained.
[0034]In the judgment part 7, it is judged whether based on the value theta of the degree of angle of inclination of the input sentence document detected in said detected inclination part 6, inclination of said input sentence paintings-and-calligraphic-works image is amended. Here, in consideration of the document structure analysis and understanding capability of a document reader which are set, for example as the latter part, or character reading capability, the judgment about implementation of inclination of an input part document is performed by the following methods. That is, a document reader performs the following judgments by the following (2) types, when it turns out beforehand that it does not interfere with reading of a character etc., if

inclination of an input sentence document is less than **nu**.
[0035]
- In the case of nu <= theta <= nu : Inclination correction processing is not carried out. When other : Inclination correction processing is carried out. -- The procedure of the document image detected inclination method of this invention is ended by more than (2).
[0036]In applying the above-mentioned document image detected inclination method to a document reader, it supplies further the degree theta of angle of inclination of the input sentence document detected by the above-mentioned document image detected inclination method to the document image inclination correction part 8. In the document image inclination correction part 8, an input sentence paintings-and-calligraphic-works image is rotated at the angle theta detected in the document image detected inclination part, inclination of an input sentence paintings-and-calligraphic-works image is amended, and the picture after amendment is supplied to the document reading part 10. As a result, in the document reading part 10, the input sentence paintings-and-calligraphic-works image which always does not have inclination will be inputted, and stable reading processing is realized.
[0037]The <2nd example> In the 1st example mentioned above, we decided to detect inclination of an input sentence document by detecting the direction of the character string contained in a local domain. At this time, as a method of detecting the angular orientation of a character string, it scanned to two or more angular orientation, and how to detect an angle with the largest complexity was explained in the range of the degree of **lambda from either the horizontal axis or the vertical axis. This method supposes that the direction of a character string of an input sentence document must be known. That is, if the direction of a character string of the input sentence document was level (lateral writing), the detection range of the degree of angle of inclination was made into the degree of **lambda from the horizontal axis (0 times), and if the direction of a character string is vertical (vertical writing), inclination of an input sentence document will be detected for the detection range of the degree of angle of inclination from the vertical axis (90 degrees) as a degree of **lambda. In this method, when the direction of a character string of an input sentence document is strange, there is no telling into which the detection range of complexity should be made. Then, it explains, referring to drawing 7 for the <detected inclination method 3> which is a method which can detect inclination of an input sentence document, when the direction of a character string is strange. Here, a different portion from the detected inclination method described in the 1st example is described.
[0038]<Detected-inclination method 3>: Since the processing from the processing in the binarization processing part 2 in drawing 7 to the local domain extraction part 4 is the same as that of Example 1, omit explanation.
[0039]In the detected inclination method 3, the data management part 5 is changed as follows. That is, although horizontal or data is managed in the vertical direction of either in the 1st example, data is managed in both directions here. After managing data for every horizontal scanning line in the horizontal data management part 11 with either one of the above <data management method 1> or the above <data management method 2> (the data obtained at this time is made into horizontal local data), Furthermore in the perpendicular direction data management part 12, also perpendicularly, data is managed for every scanning line (the data obtained at this time is set to vertical localdata).
[0040]In the horizontal detected inclination part 13, first, From Step 1 of said detected inclination method 2 to the step 5 is applied from Step 1 of said detected inclination method 1 to horizontal local data extracted from said local domain La to Step 3 in the range of a horizontal

axis (0 times) to the degree of **lambda, Complexity of two or more angular orientation: Extract horizontal complexity. It ranks second, In the perpendicular direction detected inclination part 14, from a vertical axis (90 degrees), in the range of the degree of **lambda from Step 1 of the above <detected inclination method 1> to Step 3. Or from Step 1 of the above <detected inclination method 2> to the step 5 is applied to vertical local data extracted from said local domain La, and complexity:vertical complexity of two or more angular orientation is extracted.
[0041]And it determines whether to compare horizontal complexity with vertical complexity in the inclination direction discrimination section 15, and to detect inclination of an input sentence document from distribution of which complexity. This method may be realized by the discriminating method shown below, for example. Here the maximum in horizontal complexity max horizontalcomplexity, The minimum min horizontal complexity, (Angle with max horizontal complexity) The sum of two horizontal complexity of the degree of **sigma and max horizontal complexity is made into sumhorizontal complexity, The maximum in vertical complexity max verticalcomplexity, The minimum min vertical complexity, (Angle with max vertical complexity) The sum of two vertical complexity of the degree of **sigma and max vertical complexity is made into sum vertical complexity.
[0042]Let an angle with max vertical complexity be an angle of inclination of an input sentence document at the time of <discriminating method 1>:max horizontal complexity < max vertical complexity+th1.
[0043]Let an angle with max horizontal complexity be an angle of inclination of an input sentence document at the time of max horizontal complexity+th1 > max vertical complexity.
[0044]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible). Here, it is th1. : It is considered as a threshold.
[0045]<Discriminating method 2> : (max horizontal.) At the time of complexity - min horizontal complexity<(max vertical complexity - min vertical complexity)+th2. Let an angle with maxvertical complexity be an angle of inclination of an input sentence document.
[0046]At the time of (max horizontal complexity - min horizontal complexity)+th2 > (max vertical complexity - min vertical complexity). Let an angle with max horizontalcomplexity be an angle of inclination of an input sentence document.
[0047]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible). Here, it is th2. : It is considered as a threshold.
[0048]Let an angle with max vertical complexity be an angle of inclination of an input sentence document at the time of <discriminating method 3>:sum horizontal complexity < sum vertical complexity+th3.
[0049]Let an angle with max horizontal complexity be an angle of inclination of an input sentence document at the time of sum horizontal complexity+th3 > sum vertical complexity.
[0050]When other, the angle of inclination of an input sentence document is made into detection impossible (distinction is impossible).
[0051]<Discriminating method 4>:if (distinction of the discriminating method 1 is not impossible) The result of the discriminating method 1 is adopted.
[0052]else if (distinction of the discriminating method 1 is impossible)
if (distinction of the discriminating method 2 is not impossible) The result of the discriminating method 2 is adopted.
[0053]else if (distinction of the discriminating method 2 is impossible)
if (distinction of the discriminating method 3 is not impossible) The result of the discriminating method 3 is adopted.

else if (distinction of the discriminating method 3 is impossible)
The angle of inclination of an input sentence document is made into detection impossible (distinction is impossible).
[0054]Since the decision processing performed by the judgment part 7 is the same as that of the 1st example, explanation is omitted. If the above processing procedure is used, before detecting inclination of an input sentence document, even if the direction of a character string is strange, inclination of an input sentence document is correctly detectable beforehand.
[0055]As a result of applying the above processing, in making an angle with max horizontal complexity into the angle of inclination of an input sentence document, In making into the angle of inclination of an input sentence document the angle which makes horizontal the direction of a character string of an input sentence document, and has max vertical complexity, The direction of a character string of an input sentence document is distinguished, and it may be made to supply the discriminated result to a latter document reader by making perpendicular the direction of a character string of an input sentence document. However, the direction of the character string written in the input sentence document in this case is horizontal, or is restricted to one of vertical.
[0056]It is the method explained in the 1st example of <the 3rd example>, and is angular resolution, for example 0.1 in considering it as a degree and detecting the degree of angle of inclination of an input sentence document, For example, it is near the angle of inclination theta 1 of an input sentence document in case angular resolution is 1 time (for example, theta1 -0.5 <= theta <= theta 1 the range of +0.5), and is angular resolution further 0.1 It must be considered as a degree and the detailed degree of angle of inclination of an input sentence document must be detected. Therefore, the method explained in the 1st example is desired angular resolution 0.1 When below a degree carries out, processing time will start (for example, in <the detected inclination method 2>, Step 1 and Step 2 must be applied further too many 11 times). So, it is 0.1 here. The <detected inclination method 4> which is the method of performing detected inclination processing at high speed by the angular resolution of a degree is explained. After <the detected inclination method 4> detects the degree theta 1 of angle of inclination of an input sentence document by the angular resolution of 1 time with the method explained in the 1st example, Complexity of theta 1: max complexity and theta 1 Complexity of -1 ": before complexity and theta 1 Approximation reasoning or fuzzy reasoning from three complexity of the +1 degree complexity aftercomplexity. The degree theta 2 of angle of inclination in case it uses and angular resolution is 0.1 degree or less is theta 1. -0.5 It is theta 1 above. +0.5 It is presumed which angle of the following ranges it is.
[0057]It is not necessarily guaranteed that values, such as max complexity and before complexity which were obtained in the 1st detected inclination part, and after complexity, are respectively reliable exact values. Therefore, by this method, it is suitable to such an inaccurate value, and the purpose of processing information efficiently with an ambiguous form and obtaining an appropriate result is carried out. The angle detection algorithm containing the above ambiguities shown by this method is "if. It consists of procedure which interprets the reasoning and the inference result by two or more rules of the form of antecedent part then consequent part", and presumes the degree of angle of inclination. Hereafter, <the detected inclination method 4> is explained according to the block diagram of drawing 8.
[0058]<Detected-inclination method 4>: The processing set and carried out by the 1st detected inclination part 16 from the binarization processing part 2 of the block diagram shown in drawing 8 is based on the method explained in the 1st example. However, the 1st detected

inclination part 16 makes angular resolution sigma=1 degree, and detects the degree of angle of inclination of an input sentence document.
[0059]At the 2nd detected inclination part 17, it is max complexity, before complexity, after complexity and theta 1, and theta 1 from the 1st detected inclination part 16. -1 and theta 1 +1 is received. And it is angular resolution by using three rules including the ambiguous variable shown below as opposed to these six values 0.1 The degree of angle of inclination of an input sentence document when it is considered as a degree is detected. Here, the larger one is set to second complexity among before complexity and after complexity.
[0060]Rule 1: If the difference of before complexity and after complexity is small, theta 2 is near theta 1.
[0061]Rule 2: If the difference of second complexity and max complexity is small, theta 2 is in the middle of an angle with theta 1 and second complexity.
[0062]Rule 3: If the difference of second complexity and max complexity is large, theta 2 is near theta 1.
[0063]The ambiguous variable of the underline part in the three above-mentioned rules expresses the degree about the truth of the proposition of the antecedent part included all over the Ruhr, and a consequent part with a value with the section [0, 1].
[0064]In actual processing, the above-mentioned rule is expressed as follows.
[0065]
Rule 1: If diff1 is A1 then theta2 is B1.
Rule 2: If diff2 is A2 then theta2 is B-2.
Rule 3: If diff2 is A3 then theta2 is B1.
diff1 =|before complexity. - after complexity | A1 = 1- diff1 x 10 / max complecity -- (3) (however) diff2 = max complecity - second complecity -- (4) It is referred to as A1 =0 at the time of A1 <0. -- A2 = 1 (5) - diff1 x 10 / max complecity (however, at the time of A2 <0.) it is referred to as A2 =0 -- 1 (at the time of theta1-0.5 <= theta<=theta 1.) -- A3 = 1 - A2 -- B1 = 2xtheta - 2xtheta1 + (7) (6) -2xtheta+ 2xtheta1 + 1 (at the time of theta1 < theta<=theta 1+0.5) -- (8) Angle with B-2 = if second complexity is theta1 -1 then 2xtheta - 2xtheta1 + 2 (at the time of theta1-1 <= theta<=theta 1-0.5)
-2xtheta+ 2xtheta1 (at the time of theta1-0.5 < theta<=theta 1)
-- (9) Angle with else if second complexity is theta1 Angle with +1 else if second complexity is theta1 +1 then 2xtheta - 2xtheta1 (at the time of theta1 <= theta<=theta 1+0.5)
-2xtheta+ 2xtheta1 + 2 (at the time of theta1+0.5 < theta<=theta 1+1)
-- (10) Here, |k| is taken as the absolute value of k. A1 is a membership function expressing "the difference of before complexity and after complexity is small", When it comes to A1 <0, it comes, and is referred to as A1 =0, and A2 is a membership function expressing "the difference of second complexity and max complexity is small", When it comes to A2 <0, it comes, and is referred to as A2 =0, and A3 is a membership function expressing "the difference of second complexity and max complexity is large." B1 is a membership function (considerable in [B1] drawing 9) expressing "near theta 1", and B-2 is a membership function (equivalent to B-2 in drawing 9) expressing "the middle of an angle with theta 1 and second complexity."
[0066]<The detected inclination method 4> performs reasoning for every rule first, and obtains an inference result. The inference result in each rule expresses the degree (namely, membership function) of the truth of the consequent part of each rule, and then unifies this (the membership function obtained by integration is made into B'). And the inference result integrated is interpreted by a means to search for the center of gravity y of membership function B', and it is

an interpretation result 0.1 It is considered as the degree of angle of inclination of the input sentence document detected by the angular resolution of the degree. Below, a concrete calculation method is explained.
[0067]Step 1: Calculation of the goodness of fit of the antecedent part of each rule, and selection of an application rule.
[0068]In the rule 1, the value (it is considered as the goodness of fit of the antecedent part of the rule 1) of A1 is calculated, the value (it is considered as the goodness of fit of the antecedent part of the rule 2) of A2 is calculated in the rule 2, and the value (it is considered as the goodness of fit of the antecedent part of the rule 3) of A3 is calculated in the rule 3. Here, at the time of A1 >=A3, it supposes that the rule 3 is not applied and suppose that the rule 3 is applied as the rule 1 at the time of A1 < A3 (only the rule 1 and the rule 2 will be used in the following calculations).
[0069]Step 2: Calculation and integration of the inference result of each rule.
[0070]First, the following (11) types are asked for inference result B1' of the rule 1 with the application of the goodness of fit A1 of the rule 1.
[0071]
B1'= A1 lambda B1 -- (11) Specifically, this is cutting the membership function B1 by A1 like drawing 10. As a result, B1' becomes a membership function like drawing 10.
[0072]Next, the following (12) types are asked for inference result B-2' of the rule 2 with the application of the goodness of fit A2 of the rule 2.
[0073]
B-2'= A2 lambda B-2 -- (12) Specifically, this is cutting membership function B-2 by A2 like drawing 11. As a result, B-2' becomes a membership function like drawing 11.
[0074]And B1' and B-2' are unified and membership function B' like drawing 12 is built.
[0075]Step 3: Presumption of the degree of angle of inclination by the interpretation of an inference result.
[0076]An inference result is interpreted by searching for by the following (13) types, the weighting average y, i.e., "the center of gravity of membership function B'", by the goodness of fit of the inference result in each rule. And let the center of gravity y be the degree of angle of inclination of an input sentence document.
[0077]
y = / (integralB'(theta) thetadtheta) (integralB'(theta) dtheta) -- (13) Change of the contents and the number is possible for the rule used above <the detected inclination method 4>. Modification of the membership function used with each rule is also possible, and may change if needed. It is also possible to use the learned neural network instead of said membership function furthermore. In addition, the operation which derives an inference result in each rule can also use known various methods.
[0078]In the 1st example of <the 4th example>, when applying this invention to a document reader, an input sentence document is rotated using the degree of angle of inclination of the input sentence document detected by the detected inclination method by this invention, and it is supposed that the input sentence paintings-and-calligraphic-works image which amended inclination is supplied to a document reader etc. In this case, detected inclination processing is detected in desired accuracy, and the picture further changed by inclination correction processing may add as follows the function to check whether it is amended within desired accuracy (for example, 0 degree**0.5 degree). The processing procedure which realizes the above-mentioned acknowledgement function is explained using drawing 13.
[0079]The black pixel fusion processing carried out in the input sentence paintings-and-

calligraphic-works image detected inclination part 8 in drawing 13, local domain extracting processing, data management processing, and decision processing are the same as that of what was described in Example 1, Since detected inclination processing is the same as processing by one of methods among the above <detected inclination mode of processing 1-4>, explanation is omitted. In the following document image rotation processing part 18, input sentence paintings-and-calligraphic-works rotation of image processing is carried out by methods, such as "a high velocity revolution method of the picture by the parallel translation of coordinates" (******C, 105, 3, pp.61-68-1985), using the angle of inclination of the input sentence document detected by the above-mentioned detected inclination processing. And the above-mentioned detected inclination processing is again performed to said rotated picture after that, and the inclination is detected. In the confirming processing part 19, if the degree of angle of inclination of said rotated picture is an angle (for example, 0 degree**0.5 less than degree) of the request in a desired error span, Said rotated input sentence paintings-and-calligraphic-works image is supplied to a latter document reader, and if the degree of angle of inclination of said rotated picture is not an angle of the request in a desired error span, reinput of an input sentence document will be demanded from a user.

[0080]The above processing procedure may be carried out to procedure like drawing 14. That is, processing procedure of drawing 14 is repeatedly performed until the degree of angle of inclination of the picture turning around the above-mentioned inclination rotating process, the above-mentioned detected inclination processing, and the above-mentioned confirming processing turns into an angle of the request in a desired error span. If the degree of angle of inclination of the rotated picture does not turn into an angle of the request in a desired error span even if it repeats h times at this time, he is trying to demand reinput of an input sentence document from a user.

[0081]In the range which does not deviate from the gist, it can change variously, and can realize, this invention can be made into a various application, and it can have it.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the composition of one example of the document detected inclination method with which this invention was applied.

[Drawing 2]It is an explanatory view showing the example which divided the input sentence paintings-and-calligraphic-works image into n pieces x m mesh.

[Drawing 3]It is an explanatory view showing the example of extraction of the local domain in an input sentence paintings-and-calligraphic-works image.

[Drawing 4]It is an explanatory view showing the example which carried out the division-into-equal-parts rate of the input sentence paintings-and-calligraphic-works image to the banded region long to n horizontal directions.

[Drawing 5]It is a figure explanatory view showing the example which carried out the division-into-equal-parts rate of the field S1 of an input sentence paintings-and-calligraphic-works image to the perpendicularly long banded region.

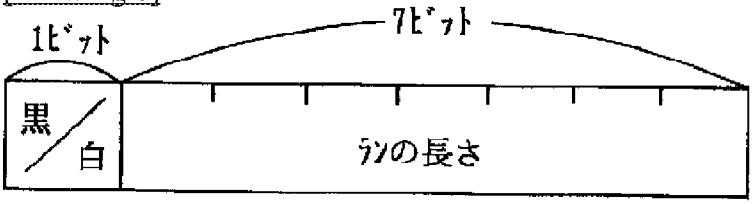
[Drawing 6]It is an explanatory view showing the structure of run length numerals.

[Drawing 7]It is a block diagram showing the composition of the document detected inclination method which detects inclination of an input sentence document in horizontal and vertical both directions.

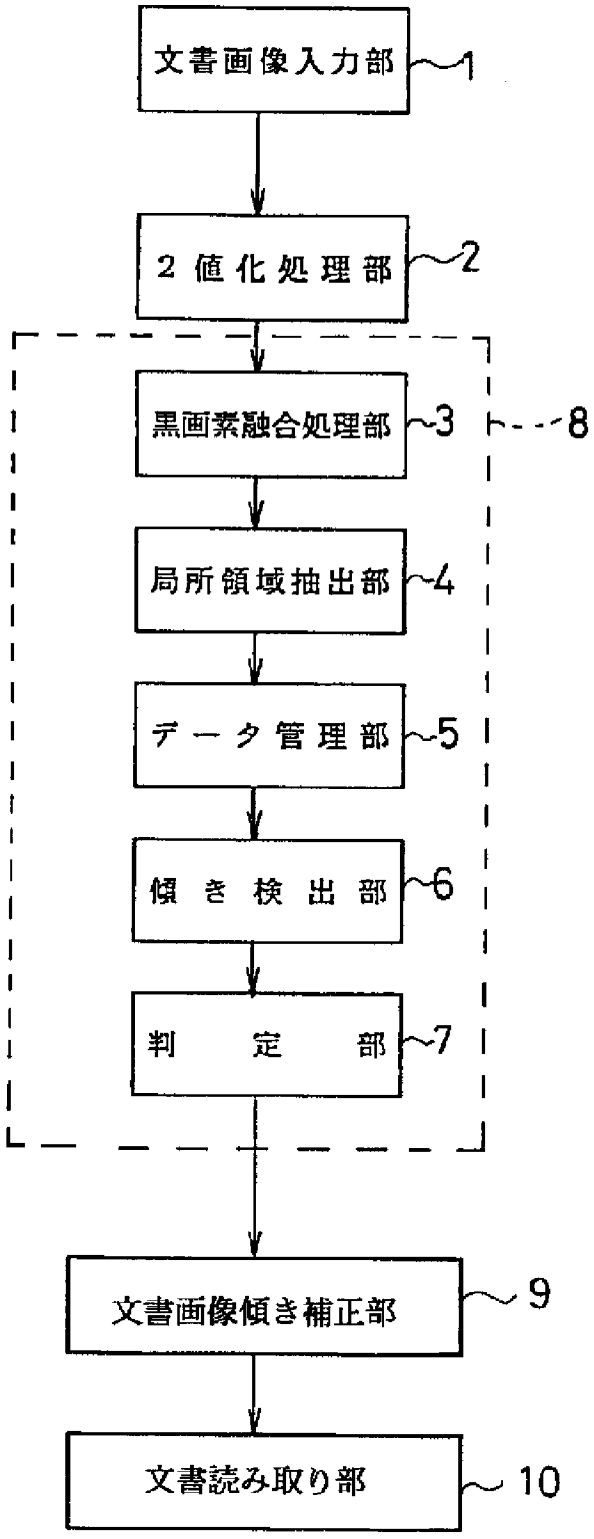
[Drawing 8]It is a block diagram showing another composition of a document detected inclination method.
[Drawing 9]It is an explanatory view showing an example of the membership function used for document detected inclination processing.
[Drawing 10]It is an explanatory view showing an example of the membership function obtained by the inference result of one rule.
[Drawing 11]It is an explanatory view showing an example of the membership function obtained by the inference result of one rule.
[Drawing 12]It is an explanatory view showing an example of the membership function produced by unifying an inference result.
[Drawing 13]It is a figure showing the composition of the document detected inclination method incorporating an acknowledgement function.
[Drawing 14]It is a figure showing another composition of the document detected inclination method incorporating an acknowledgement function.
[Description of Notations]
1 Document image input part
2 Binarization processing part
3 Black pixel fusion processing part
4 Local domain extraction part
5 Data management part
6 Detected inclination part
7 Judgment part
8 Document image detected inclination part
9 Document image inclination correction part
10 Document reading part
11 Horizontal data management part
12 Perpendicular direction data management part
13 Horizontal detected inclination part
14 Perpendicular direction detected inclination part
15 Inclination direction judging part
16 The 1st detected inclination part
17 The 2nd detected inclination part
18 Document image rotation processing part
19 Confirming processing part

DRAWINGS

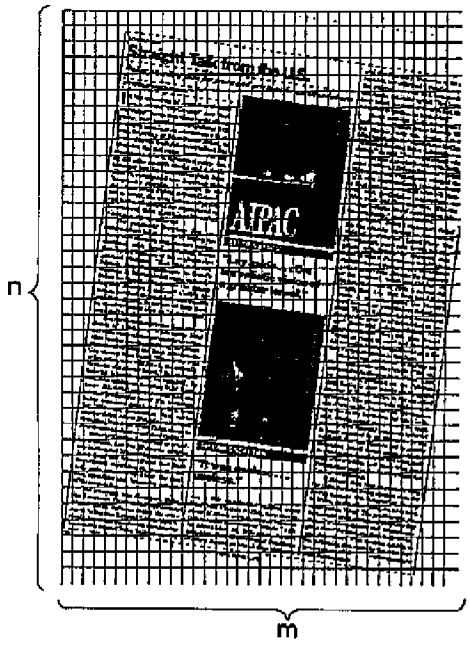
[Drawing 6]



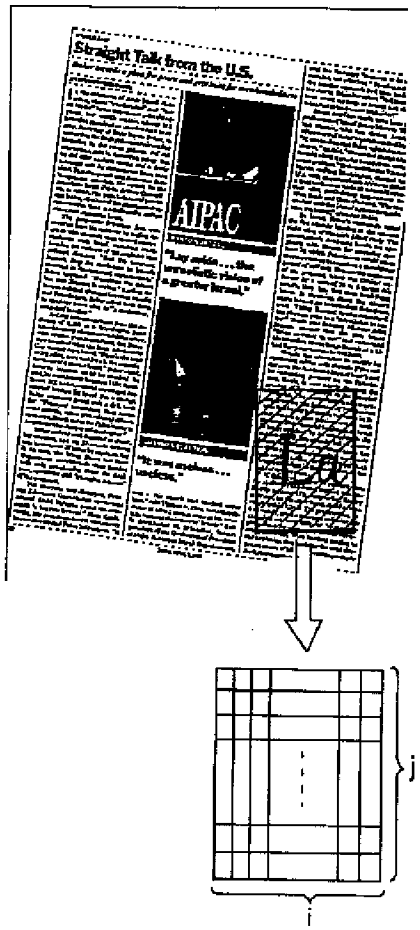
[Drawing 1]


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
8
局所領域抽出部
4
データ管理部
5
傾き検出部
6
判定部
7
文書画像傾き補正部
9
文書読み取り部
10

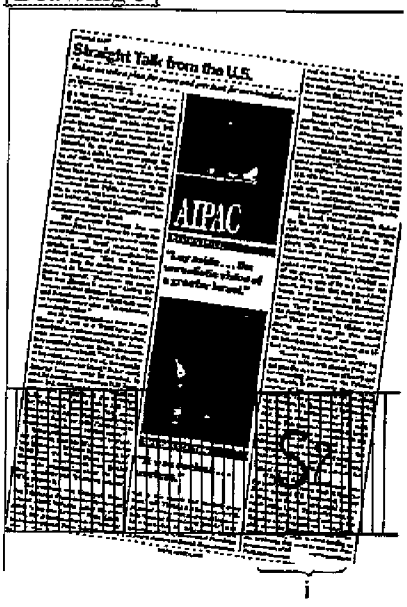
[Drawing 2]



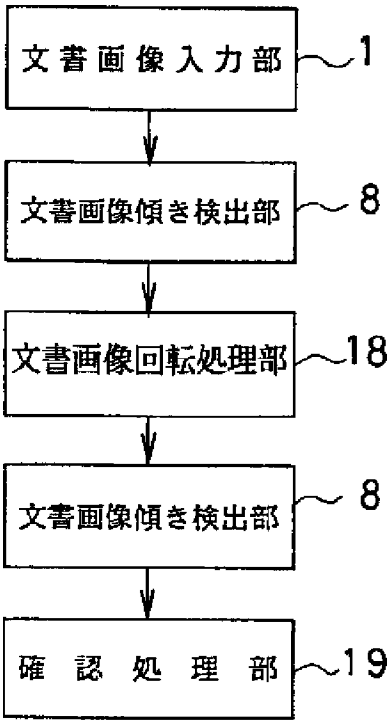
[Drawing 3]



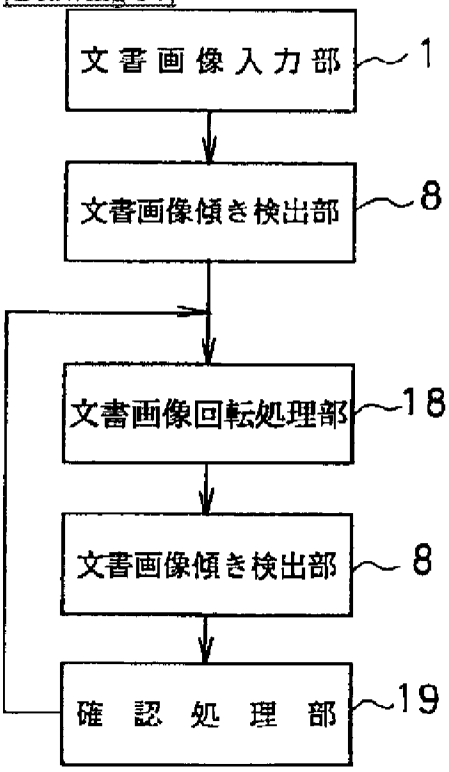
[Drawing 5]



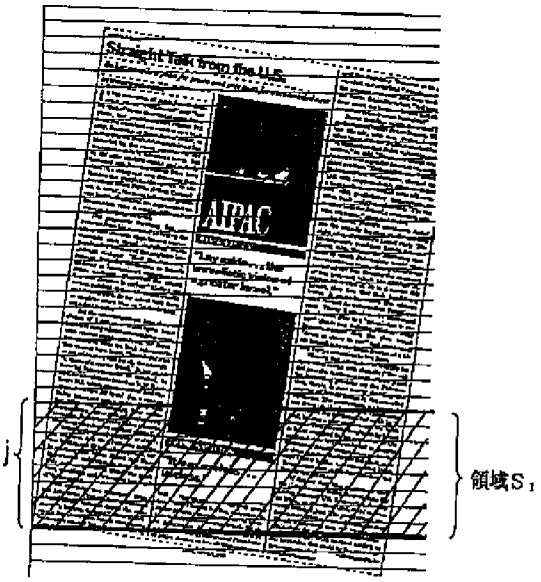
[Drawing 13]



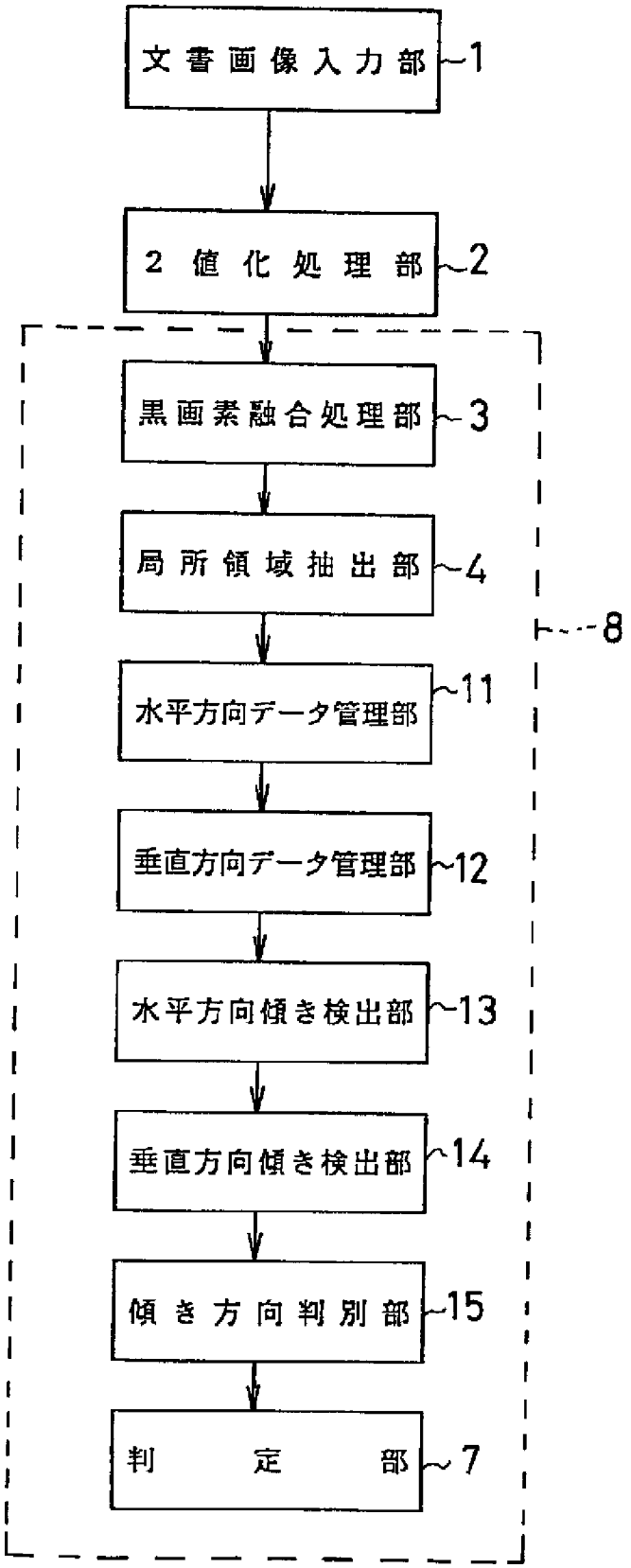
[Drawing 14]



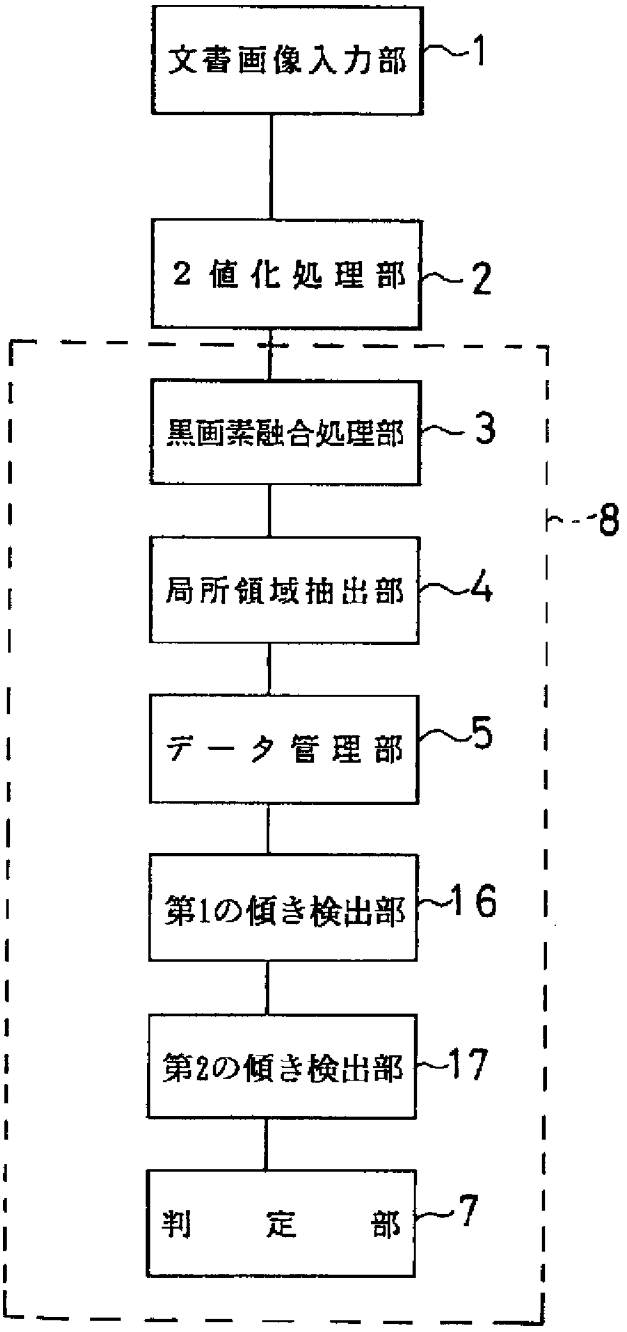
[Drawing 4]



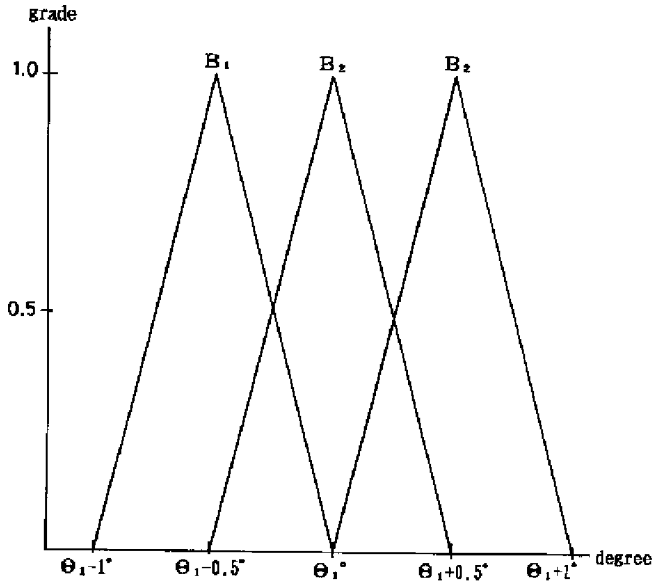
[Drawing 7]


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
局所領域抽出部
4
8
水平方向データ管理部
11
垂直方向データ管理部
12
水平方向傾き検出部
13
垂直方向傾き検出部
14
傾き方向判別部
15
判定部
7

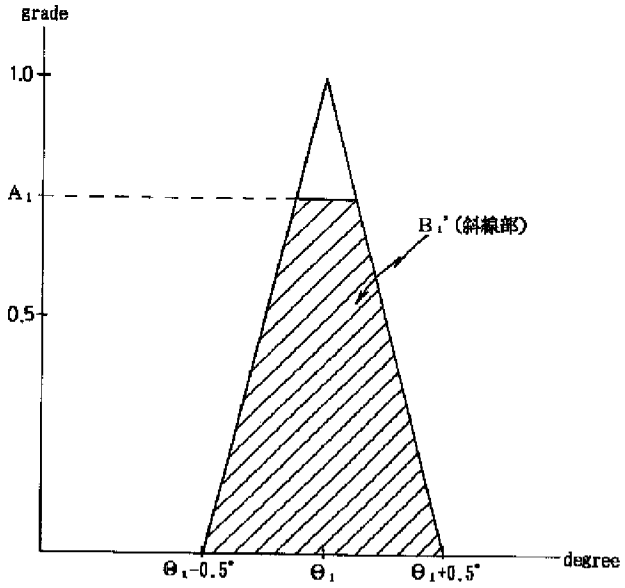
[Drawing 8]


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
8
局所領域抽出部
4
データ管理部
5
第1の傾き検出部
16
第2の傾き検出部
17
判定部
7

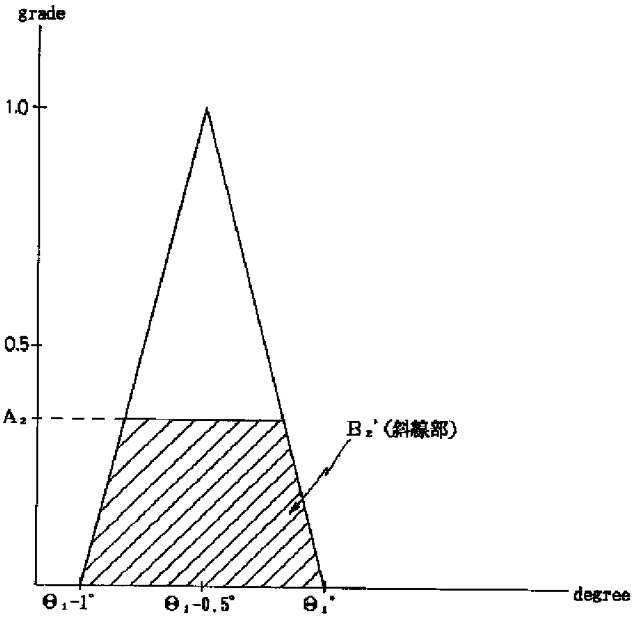
[Drawing 9]



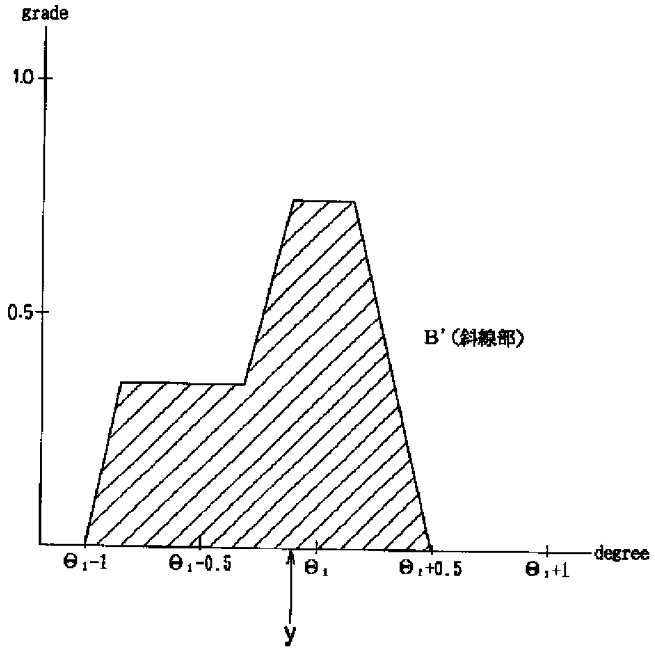
[Drawing 10]



[Drawing 11]



[Drawing 12]



* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

[Kind of official gazette]Printing of amendment by the regulation of 2 of Article 17 of Patent Law
[Section classification] The 3rd classification of the part VI gate
[Publication date]October 29, Heisei 11 (1999)

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[International Patent Classification (6th Edition)]

G06K 9/32

[FI]
G06K 9/32

[Written amendment]
[Filing date]December 25, Heisei 10
[Amendment 1]
[Document to be Amended]Specification
[Item(s) to be Amended]The name of an invention
[Method of Amendment]Change
[Proposed Amendment]
[Title of the Invention]A document image detected inclination device and a method for the same
[Amendment 2]
[Document to be Amended]Specification
[Item(s) to be Amended]Claim
[Method of Amendment]Change
[Proposed Amendment]
[Claim(s)]
[Claim 1]A document image detected inclination device comprising:
A means to extract complexity of a document image for two or more angular orientation of every.
A means which detects an angle of a direction with the largest complexity and considers the angle as inclination of said document image.

[Claim 2]The document image detected inclination device according to claim 1 which makes a value which a means to extract said complexity scanned said document image to arbitrary angular orientation, calculated the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element on one scanning line, and added it with said whole document image complexity of arbitrary angular orientation.
[Claim 3]A document image detected inclination device comprising:
A means by which a character string extracts a local domain which occupies most in a document image.
A means to extract complexity of said local domain for two or more angular orientation of every.
A means which detects an angle of a direction with the largest complexity from said extracted complexity, and considers the angle as inclination of said document image.

[Claim 4]The document image detected inclination device comprising according to claim 3:
A means to divide a document image into n pieces x m mesh.
A means to calculate the number of times which changes from a black pixel or a black pixel to a white picture element from a white picture element on one scanning line in each mesh.
A means to extract i pieces x j local domains [****] containing a scanning line used as the number of times which changes to a black pixel from said most many of white picture elements, or a white picture element from a black pixel as a local domain where said character string occupies most.

[Claim 5]The document image detected inclination device comprising according to claim 1:
A means to ask for complexity of some angular orientation by angular resolution of the degree of alpha, and to extract angular orientation where complexity is among these the largest when extracting complexity of a document image to two or more angular orientation in a local domain which is the whole document image or its part.
A means to ask near the angle of said direction with the largest complexity for complexity in two or more directions by angular resolution of the degree smaller than the degree of alpha of sigma, among those to extract an angle of a direction with the largest complexity as inclination of a document image.

[Claim 6]The document image detected inclination device comprising according to claim 1:
A means to scan a local domain which is the whole document image or its part in the direction of plurality by angular resolution of the degree of sigma, and to extract complexity for every angular orientation.
A means to presume inclination of said document image by angular resolution smaller than sigma from distribution of a size of three complexity, complexity of angle $theta_{max}$ of a direction with the maximum complexity, complexity of the degree of $theta_{max}$-sigma, and complexity of the degree of $theta_{max}$+sigma.

[Claim 7]A document image detected inclination device comprising:
A means to binary-ize a document image.
A means to unite a black pixel which changes into a black pixel all continuous white picture elements below a length delta pixel which was level or was inserted into a black pixel for every scanning line at least in vertical one side, and approaches.
A means to scan a document image to two or more angular orientation, and to extract complexity of said document image for for [every] all directions to said changed document image.
A means which detects an angle of a direction with the largest complexity and considers this as inclination of said input sentence paintings-and-calligraphic-works image.

[Claim 8]A document image inclination detection method extracting complexity of a document image for two or more angular orientation of every, detecting an angle of a direction with the largest complexity, and considering the angle as inclination of said document image.
[Claim 9]A document image inclination detection method extracting a local domain where a character string occupies most in a document image, extracting complexity of said local domain for two or more angular orientation of every, detecting an angle of a direction with the largest complexity from said extracted complexity, and considering the angle as inclination of said document image.
[The amendment 3]
[Document to be Amended]Specification
[Item(s) to be Amended]0001
[Method of Amendment]Change
[Proposed Amendment]
[0001]
[Industrial Application]When this invention inputs a document into a document reader or a document filing device, it detects inclination of an input sentence document, and it relates to a document image detected inclination device to amend and a method for the same.

Your Ref: 07844-249JP1
Our Ref: PA941

Translation of Selected Portions of Pat. Laid-open Official Gazette

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Appln. Date: December 26, 1991
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Laid-open Pub. Date: July 13, 1993

Inventor(s): Yasuhito Ishiya
Applicant(s): K.K. Toshiba
Attorney(s): Hidekazu Miyoshi et al.

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1. Title of the Invention

SYSTEM FOR DETECTING THE INCLINATION OF A DOCUMENT IMAGE

2. Claims

(omitted)

3. Detailed Description of the Invention (Selected Portions)

1)

(omitted)

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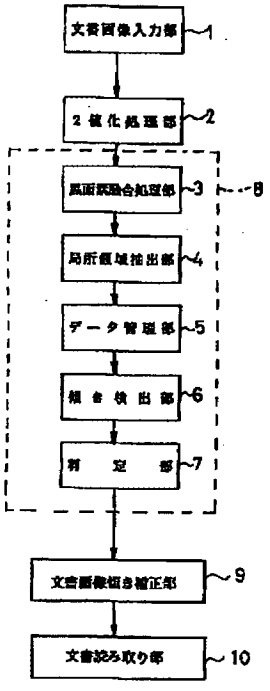
(54)【発明の名称】　文書画像傾き検出方式

(57)【要約】
【目的】　本発明は、様々な文書画像の傾きを効率的にかつ正確に検出できる文書画像傾き検出方式を提供することを目的とする。
【構成】　入力された画像データから、文字列が大半を占めている局所領域を抽出する手段と、局所領域を複数の角度方向に走査して各方向の複雑度を検出する手段と、最も複雑度が大きくなる角度方向を入力画像データの傾きとして検出する手段から構成される。
【効果】　本発明によれば、入力文書の局所領域の複雑さを調べることにより傾きを検出するので、複雑さが文字列部に対して比較的小さい図・写真・ノイズなどによる影響を受けず、効率的に入力文書の傾きを検出できる。



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【特許請求の範囲】

【請求項1】　複数の角度方向ごとに文書画像の複雑度を抽出する手段と、最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとする手段とを具備したことを特徴とする文書画像傾き検出方式。

【請求項2】　前記複雑度を抽出する手段は、任意の角度方向に前記文書画像を走査して、1本の走査線上で白画素から黒画素または黒画素から白画素に変化する回数を計数し、それを前記文書画像全体で加算した値を任意の角度方向の複雑度とする請求項1記載の文書画像傾き検出方式。

【請求項3】　文書画像中で文字列が大半を占める局所領域を抽出する手段と、前記局所領域の複雑度を複数の角度方向ごとに抽出する手段と、前記抽出された複雑度から最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとする手段とを具備したことを特徴とする文書画像傾き検出方式。

【請求項4】　文書画像をn個×m個のメッシュに分割する手段と、各メッシュ内において1本の走査線上で白画素から黒画素または黒画素から白画素に変化する回数を計数する手段と、最も多くの前記白画素から黒画素または黒画素から白画素に変化する回数となる走査線を含む連続なi個×j個の局所領域を前記文字列が大半を占める局所領域として抽出する手段とを具備した請求項3記載の文書画像傾き検出方式。

【請求項5】　文書画像全体またはその一部分である局所領域において複数の角度方向に文書画像の複雑度を抽出する際に、α度の角度分解能でいくつかの角度方向の複雑度を求め、これらのうち最も複雑度の大きい角度方向を抽出する手段と、前記最も複雑度の大きい方向の角度付近をα度より小さいσ度の角度分解能で複数の方向に複雑度を求め、それらのうち最も複雑度の大きい方向の角度を文書画像の傾きとして抽出する手段を具備した請求項1記載の文書画像傾き検出方式。

【請求項6】　文書画像全体またはその一部分である局所領域をσ度の角度分解能で複数方向に走査して各角度方向ごとに複雑度を抽出する手段と、最大複雑度を持つ方向の角度θ_{max}　の複雑度とθ_{max}　－σ度の複雑度およびθ_{max}　＋σ度の複雑度の3つの複雑度の大きさの分布から前記文書画像の傾きをσより小さい角度分解能で推定する手段とを具備した請求項1記載の文書画像傾き検出方式。

【請求項7】　文書画像を2値化する手段と、水平または垂直方向の少なくとも一方にて、各走査線ごとに黒画素に挟まれた長さδ画素以下の連続する白画素をすべて黒画素に変換して近接する黒画素を融合する手段と、前記変換された文書画像に対して、複数の角度方向に文書画像を走査して各方向ごとに前記文書画像の複雑度を抽出する手段と、最も複雑度が大きい方向の角度を検出し、これを前記入力文書画像の傾きとする手段とを具備

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したことを特徴とする文書画像傾き検出方式。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、文書読み取り装置または文書ファイリング装置等に文書を入力する際に入力文書の傾きを検出し、補正する文書画像傾き検出方式に関する。

【0002】

【従来の技術】一般に、文書読み取り装置では、入力文書の傾きが検出・補正されていると入力文書のレイアウト等の構造理解や入力文書に記載されている文字の読み取りが、傾きを補正しない場合に較べて容易となる。

【0003】入力文書の傾きを検出する際、入力文書に罫線などの基準が常に存在するとは限らないので一般には文字列の傾きを検出して補正する必要がある。従来、文字列の傾きを検出する方法として、例えば「書式指定情報によらない紙面構成要素抽出法」（電子情報通信学会、論文誌D、ｖｏｌ、Ｊ６６－Ｄ、Ｎｏ．１、ＰＰ１１１～１１８、１９８３）に示されているように、文書全体に対して黒画素部の周辺分布を複数の角度方向に対して求め、分布が最も先鋭となる方向の角度を探索する方法が提案されている。しかしこの方法には図・写真およびノイズ等による悪影響を受け易く、処理時間にコストがかかるいう問題点があった。この他に、例えば、「文書画像の傾き補正のための一方式」（電子情報通信学会、論文誌D、ｖｏｌ、Ｊ６９－Ｄ、Ｎｏ．１１、ＰＰ１８３３～１８３４、１９８６）に示されているように、入力文書全体に輪郭抽出処理を施すことにより求めた黒結成分矩形に対して外接長方形の底辺に関する周辺分布が鋭くなる方向を抽出して文書画像の傾きを検出する方式が提案されている。しかし、この方式では、全体の処理における輪郭抽出処理の比重が大きく、実用的な処理時間で黒連結成分の外接長方形を抽出できないという問題点があった。

【0004】

【発明が解決しようとする課題】このように、従来の文書画像傾き検出方式および装置では、図・写真およびノイズ等により悪影響を受け易いという欠点があり、さらに処理時間に関してコストがかかるという問題点があった。

【0005】この発明はこのような従来の課題を解決するためになされたもので、その目的とするところは、入力文書画像中に図・写真・ノイズ等が含まれていても文書画像の傾きを効率良く正確に検出することのできる文書画像傾き検出方式を提供することにある。

【0006】

【課題を解決するための手段】上記目的を達成するため、本発明は2値に量子化された文書画像において水平または垂直方向のどちらか一方向あるいは両方向に黒画素に挟まれた長さδ画素以下の白画素を黒画素に変換す

ることにより近接する黒画素を融合した画像を生成する手段と、前記近接する黒画素を融合した画像をｎ個×ｍ個のメッシュに分割して、各メッシュ内において白画素から黒画素あるいは黒画素から白画素に変化する回数を計数し、その和が最も多くなるような連続したｉ個×ｊ個の局所領域を抽出する手段と、前記局所領域において水平または垂直方向のどちらかあるいは両方向の各走査線ごとに画像データを圧縮して管理する部分と、前記局所領域あるいは前記入力文書画像全体に対して複数の角度方向に複雑度を抽出し、更に最も複雑度の大きい方向の角度を検出することにより入力文書の傾きを検出する手段と、任意の角度分解能σ度で得られた傾き角度とその前後±σ度の角度の３つの複雑度からσより小さい角度分解能で入力文書の詳細な傾き角度を検出する手段とからなる。

【０００７】また、局所領域あるいは入力文書画像全体に対して複数の方向に複雑度を抽出し、更に最も複雑度の大きい方向の角度を検出することにより入力文書画像の傾きを推定する手段は、水平軸もしくは垂直軸から±λ度の一定範囲で適用されるものであり、この範囲において如何なる精度で角度検出が行われても良い。また上記傾きを検出する手段において、大まかな角度分解能α度ごとに角度検出を行い、かつその中で最も大きい複雑度を持つ角度付近においてさらにα度より小さい角度分解能σ度で角度検出を行うという階層的な角度検出が行われても良い。また、粗い角度分解能で入力文書の傾きを検出した後、その傾き角度付近を更に細かい精度で傾き検出を行うということを順次繰り返すことにより所望の精度で入力文書の傾き角を検出するようにしても良い。

【０００８】

【作用】本発明による文書画像傾き検出方式では、入力文書を複数の角度方向に走査して、それぞれの方向の複雑度を抽出し、複雑度が最も大きい方向の角度を探索することにより文書画像の傾きを検出するので、文字列部に較べて複雑度の小さい図・写真およびノイズ部分による影響の受けずに文書画像の傾きを検出することができる。

【０００９】また、入力文書の一部分である文字列が大半を占めている局所領域を抽出し、その部分に対して傾き検出を行うので、実用的な処理時間で入力文書の傾きを検出することができる。

【００１０】

【実施例】以下、図面に基づいて本発明の実施例について説明する。図１は本発明の文書傾き検出方式を説明するためのブロック図である。まず本発明の文書傾き検出方式の手続きを概説する。

【００１１】イメージスキャナ等の画像入力装置で構成されている画像入力部１より入力された文書画像に対して２値化処理部２で入力文書画像を２値化した後黒画素

融合処理部３で水平または垂直方向のどちらか一方あるいは両方向において、黒画素に挟まれる長さδ画素以下の白画素を黒画素に変換することにより近接する黒画素を融合し、文書画像全体に含まれる黒連結画素の数を減らした画像Ｉｓを生成する。次いで局所領域抽出部４で前記黒画素融合処理部３において生成された画像のうち最も複雑度の大きい部分領域を局所領域Ｌａとして抽出する。この局所領域Ｌａは、大半が文字列で占められていると見なすことができる。データ管理部５は、その後の処理が効率的に行われることを目的として局所領域抽出部４で抽出した局所領域Ｌａに含まれる画像を圧縮して管理する。傾き検出部６では、データ管理部５で管理されているデータを用いて入力文書画像の傾きを検出する。そして、傾き検出部６で検出された傾き角度に対して判定部７で入力文書の傾きを補正するか否かを判定する。これらのうち２値化処理部２で実施される２値化処理は現在公知である種々の手法により実現されても良い。また、２値化処理機能を有するスキャナー等を画像入力部として用いた場合には２値化処理部２は省略される。以下、各構成部分での動作を詳述する。

【００１２】黒画素融合処理部３では、水平方向または垂直方向あるいはその両方向に近接する複数の黒連結画素（一定方向に連続する黒画素）を１つの黒連結画素として入力文書中に含まれる黒連結画素の個数を減らす。この処理の目的は、傾き検出部６において複雑度を抽出するときに処理量が削減されることと、局所領域抽出部４において部分領域を抽出するときにノイズ部分や写真部分を誤って抽出しないことである。具体的には、ある長さδ画素以下より短く、かつ黒画素に挟まれている白画素をすべて黒画素に変えることにより実現する。このとき問題になるのはδという値の選び方である。傾き検出部６では画像の複雑度を抽出することにより入力文書の傾きを検出するものであるから、ここでδを大きく取ると入力文書に含まれる文字のストロークや文字同士が融合してしまうため抽出される複雑度が意味の無いものとなってしまう。したがってδは、文字のストロークや文字同士が融合せず、胡麻塩状の細かいノイズ部分やかすれている写真部分などに含まれる黒連結画素の数が少なく成る程度に小さい値とする。この処理が実施されると、ノイズ、図、写真等の複雑度が小さくなるので文字列領域部分の複雑度が入力文書中最も高くなる。なお、黒画素融合処理で得られる画像をＩｓとする。

【００１３】局所領域抽出部４では、黒画素融合処理部３で得られた画像Ｉｓから傾き検出部６の処理対象となる局所領域Ｌａを抽出する。傾き検出部６では、処理対象の画像中に含まれる文字列の傾きを検出することにより入力文書の傾きを推定するので、この局所領域抽出部４で抽出される局所領域は大半が文字列で占められている必要がある。局所領域Ｌａの検出は、画像Ｉｓの中で最も複雑度の大きい局所領域を抽出することによって実

現される。具体的な局所領域の抽出方法は例えば次のようになる。

【００１４】まず図２に示すように画像Ｉｓをｍ個×ｎ個のメッシュに分割する。次いで各メッシュごとに水平または垂直方向のどちらかの各走査線中の白画素から黒画素または黒画素から白画素に変化する回数を数え、その数をそれぞれのメッシュの複雑度とする。そして複雑度の和が最も高くなるようなｉ個×ｊ個の連続する局所領域Ｌａ（図３参照）を抽出する。

【００１５】この抽出方法は、例えば次のような近似的な方法で実現されてもよい。すなわち、図４のような水平方向に長いｎ個の帯領域ごとにそこに含まれるメッシュの複雑度を加算し、ｎ個の帯領域から最も複雑度が大きくなるような連続するｊ個の帯領域（図４中の領域ｓ１に相当）を抽出する。領域ｓ１をさらに図５のように垂直方向にｍ個に当分割して垂直方向に長い帯領域をつくり、各帯領域に含まれるメッシュの複雑度を加算し、ｍ個の帯領域から最も複雑度が大きくなるような連続するｉ個の帯領域（図５中の領域ｓ２に相当）を抽出する。領域ｓ２は、必ずしも入力文書中で最も複雑な領域であるとは限らないが、この領域で傾き検出処理を行なうことについて支障はない。

【００１６】データ管理部５では、局所領域Ｌａに含まれる画像データを水平または垂直方向のどちらか一方あるいは両方向の１本の走査線ごとに圧縮して管理する。これは、傾き検出部６において複雑度を抽出する際に処理効率を上げることを目的としている。例えば、局所領域Ｌａに含まれる画像データの管理方式として次に示す方法を採用しても良い。

【００１７】＜データ管理方法１＞：局所領域中の画像データを水平または垂直方向のどちらかあるいは両方向において図６に示すランレングス符号の並びとして表現する。＜データ管理方法２＞：水平方向または垂直方向において各走査線ごとに連続する黒画素の先頭座標（中心座標でも良い）を管理する。この時注意しなければならないことは、各黒画素の先頭座標を局所領域の左辺の座標値で正規化（すなわち各黒画素の座標値から局所領域の左辺の座標値を引く）する必要がある。そして、上記のようなデータを管理して、以後の処理に適用する。

【００１８】傾き検出部６では、データ管理部５で管理されている圧縮されたデータから入力文書の傾きを検出する。処理効率を考慮しなければ、傾き検出処理の対象画像として画像Ｉｓから抽出した局所領域Ｌａの他に前記入力画像の２値画像Ｉｂあるいは２値画像Ｉｂ中のＬａと同じ位置および同じ大きさの部分画像を用いても良い。傾き検出部６で実行される傾き検出処理は対象領域中の文字列の方向すなわち傾きを検出することにより実現される。この場合、文字列方向（水平あるいは垂直方向）は予め既知であることを前提としている。文字列の傾きは水平軸あるいは垂直軸のどちらかから±λ度の範囲内において、ある角度分解能σで複数の方向ごとに複雑度を求め、最も複雑度の大きい角度を入力文書の傾き角であるとすることにより検出される。この方式は、文字列の傾きと走査方向が一致する場合、各走査線における複雑度が最大となるという性質を利用するものである。

【００１９】複雑度の定義にはいろいろあるが、ここでは例えば、ある領域の複雑度を「走査線ごとに、そこに含まれる白画素から黒画素あるいは黒画素から白画素に変化する回数の２乗した値を求め、それを領域全体で加算した値」と定義する。また、この複雑度の定義における前記「白画素から黒画素あるいは黒画素から白画素に変化する回数」は、例えば前記データ管理方法１およびデータ管理方法２に適用する場合には黒連結画素の個数と解釈することができる。

【００２０】また、複雑度が最大となる走査方向の角度の探索方法にもいろいろな方法が考えられるが、ここでは先ずその一例として一定の角度分解能σごとに複雑度を抽出し、最大複雑度を持つ角度を検出する傾き検出方式について説明する。ただし、λはσで割り切れる値であることが望ましい。

【００２１】＜傾き検出方法１＞：図３のように入力文書が横書きに限る場合、水平軸（０度）から±λ度以内の範囲で傾きを検出すれば良い。図３の局所領域Ｌａから入力文書の傾き角度Θを求める具体的な処理は、例えば、次の４つのステップからなる。ここで、初期値としてθ　＝　－λ°とする。

【００２２】ステップ１：局所領域Ｌａを角度θの方向に走査し、各走査線ごとに「白画素から黒画素あるいは黒画素から白画素に変化する回数」を２乗した値：LINE COMPLEXITY （各走査線の複雑度とする）を求める。

【００２３】ステップ２：局所領域全体における上記「走査線ごとの複雑度：LINE COMPLEXITY 」の総和：ALL LINE COMPLEXITY を求めてこれを角度θのときの局所領域Ｌａの複雑度とする。

【００２４】ステップ３：θをσ度分増やして、ステップ１およびステップ２を行う。ただしθは、－λ°≦θ≦＋λ°を満たしている必要がある。ここでは、例えばσ＝１，λ＝３２としても良い。

【００２５】ステップ４：ステップ３で求めた２λ／σ＋１個の複雑度（σ＝１，λ＝３２としたとき６５個の複雑度が求まる）：ALL LINE COMPLEXITY のなかで最も大きい複雑度：MAX COMPLEXITYを持つ角度Θを検出して、その角度Θを入力文書の傾き角度とする。

【００２６】以上の処理の中で、例えば、ステップ１の処理において任意の角度の任意の走査線に含まれる連続する黒画素は次のように近似的に求めても良い。すなわち、局所領域Ｌａに含まれる画像が前記データ管理方法２（水平方向の各走査線ごとにおいて連続する黒画素の先頭座標と個数を管理する方法）で管理されている場

合、局所領域Laにおいて上からj番目の走査線で管理されている先頭座標がxである黒連結画素は、角度θのとき次の(1)式で求まるy番目の走査線に含まれること＊

$$y = j + \tan\theta \times x \quad \cdots(1)$$

次に複雑度が最大となる角度の探索を効率的に行う方法を以下に示す。この方法は上記傾き検出方法1において最も処理時間を要する「ステップ1およびステップ2」の処理回数を減らしたものである。すなわち、ある程度粗い角度分解能α°で最大複雑度を探索した後、その最大複雑度を持つ角度付近においてα°より小さい角度分解能σ°でさらに最大複雑度を探索し、この場合の最大複雑度を持つ角度を入力文書の傾きとする方式である。このとき、λはαとσの両方で割り切れる値であることが望ましい。

【0028】<傾き検出方法2>：この方法は前記<傾き検出方法1>において次のようにステップ3とステップ4を変更し（それぞれステップ3'とステップ4'とする）、さらにステップ5および6を追加することによって実現される。ここで、ステップ1とステップ2は、傾き検出方法1と同様なので説明を省略する。

【0029】ステップ3'：θをα度分増やして、ステップ1およびステップ2を行う。ただし$-\lambda° \leqq \theta \leqq +\lambda°$を満たしている必要がある。ここで例えばα＝4、λ＝32としても良い。

【0030】ステップ4'：ステップ3で求めた$2\lambda/\alpha+1$個の複雑度：ALL LINE COMPLEXITY1のなかで最大きい複雑度：MAX COMPLEXITY1 を持つ角度Θ1 を検出する。

※

$-\nu \leqq \Theta \leqq \nu$ の場合　：傾き補正処理を実施しない
それ以外の場合　：傾き補正処理を実施する　…(2)

以上により本発明の文書画像傾き検出方式の手続きを終了する。

【0036】上記文書画像傾き検出方式を文書読み取り装置に適用する場合には、さらに、上記文書画像傾き検出方式で検出した入力文書の傾き角度Θを文書画像傾き補正部8に供給する。文書画像傾き補正部8では、文書画像傾き検出部で検出された角度Θで入力文書画像を回転して入力文書画像の傾きを補正し、補正後の画像を文書読み取り部10に供給する。この結果、文書読み取り部10では常に傾きの無い入力文書画像が入力されることになり、安定した読み取り処理が実現される。

【0037】<第2実施例>前述した第1実施例では、局所領域に含まれる文字列の方向を検出することにより、入力文書の傾きを検出することとした。この時、文字列の角度方向を検出する方法として、水平軸または垂直軸のどちらか一方から±λ度の範囲で複数の角度方向に走査して、最も複雑度の大きい角度を検出する方法について説明した。この方法は、入力文書の文字列方向が既知でなければならないとしている。つまり、入力文書の文字列方向が水平（横書き）であるならば傾き角度の＊になる。

【0027】

※【0031】ステップ5：ステップ4'で検出した角度Θ1 の付近（例えば $\Theta1 - \alpha/2 \leqq \theta \leqq \Theta1 + \alpha/2$の範囲）で角度分解能をσとして、ステップ1～2を行う。ここで、例えばσ＝1としても良い。

【0032】ステップ6：ステップ5で求めたα＋1個の複雑度：ALL LINE COMPLEXITY2のなかで最も大きい複雑度：MAX COMPLEXITY2 を持つ角度Θ2 を検出して、その角度Θ2 を入力文書の傾き角度とする。

【0033】例えばα＝4、σ＝1として上記傾き検出方法2を適用した場合、ステップ1および2の処理回数は22回となり、前記傾き検出方法1（この方法では65回）に較べ処理量が少なくなり、高速化が可能となる。

【0034】判定部7では、前記傾き検出部6で検出された入力文書の傾き角度の値Θに基づいて前記入力文書画像の傾きを補正するか否かを判定する。ここでは、例えば後段に設定されている文書読み取り装置の文書構造解析および理解能力や文字読み取り能力を考慮して、以下の方法により入力部文書の傾きの実施に関する判定を行う。すなわち、文書読み取り装置は、入力文書の傾きが$\pm\nu°$以内であれば文字の読み取り等に支障をきたさないことが予め分かっている場合には、次の(2)式により以下のような判定を行う。

【0035】

検出範囲を水平軸（0度）から±λ度とし、文字列方向が垂直（縦書き）であるならば傾き角度の検出範囲を垂直軸（90度）から±λ度として入力文書の傾きを検出している。この方法では、入力文書の文字列方向が未知である場合には、複雑度の検出範囲をどちらにすれば良いか分からない。そこで文字列方向が未知である場合においても入力文書の傾きを検出できる方式である<傾き検出方式3>について図7を参照しながら説明する。ここでは、第1実施例で述べた傾き検出方式と異なる部分について述べる。

【0038】<傾き検出方式3>：図7における2値化処理部2における処理から局所領域抽出部4までの処理は、実施例1と同様であるので説明を省略する。

【0039】傾き検出方式3では、データ管理部5を次のように変更する。すなわち、第1実施例では、水平方向または垂直方向のどちらか一方の方向でデータを管理するが、ここでは両方向でデータを管理する。前記<データ管理方式1>または前記<データ管理方式2>のいずれか一方により水平方向データ管理部11において水平方向の走査線ごとにデータを管理した後（このとき得

られるデータをhorizontal local data とする）、さらに垂直方向データ管理部１２において垂直方向にも走査線ごとにデータを管理する（このとき得られるデータをvertical localdata とする）。

【００４０】水平方向傾き検出部１３では、まず、水平軸（０度）から±λ度の範囲で前記傾き検出方式１のステップ１からステップ３まであるいは前記傾き検出方式２のステップ１からステップ５までを前記局所領域Ｌａから抽出したhorizontal local data に対して適用し、複数の角度方向の複雑度：horizontal complexity を抽出する。次いで、垂直方向傾き検出部１４において垂直軸（90度）から±λ度の範囲で前記＜傾き検出方式１＞のステップ１からステップ３まであるいは前記＜傾き検出方式２＞のステップ１からステップ５までを前記局所領域Ｌａから抽出したvertical local data に対して適用し、複数の角度方向の複雑度：vertical complexity を抽出する。

【００４１】そして、傾き方向判別部１５においてhorizontal complexity とvertical complexity を比較してどちらの複雑度の分布から入力文書の傾きを検出するかを決定する。この方法は、例えば以下に示す判別方法により実現されても良い。ここで、horizontal complexity 中の最大値をmax horizontalcomplexity 、最小値をmin horizontal complexity 、（max horizontal complexity を持つ角度）±σ度の２つのhorizontal complexity とmax horizontal complexity の和をsumhorizontal complexity とし、vertical complexity 中の最大値をmax verticalcomplexity 、最小値をmin vertical complexity 、（max vertical complexity を持つ角度）±σ度の２つのvertical complexity とmax vertical complexity の和をsum vertical complexity とする。

【００４２】＜判別方法１＞：max horizontal complexity ＜ max vertical complexity ＋th1 のとき、max vertical complexity を持つ角度を入力文書の傾きの角度とする。

【００４３】max horizontal complexity ＋th1 ＞ max vertical complexity のとき、max horizontal complexity を持つ角度を入力文書の傾きの角度とする。

【００４４】それ以外のとき、入力文書の傾き角を検出不能（判別不能）とする。ここで、th1 ：しきい値とする。

【００４５】＜判別方法２＞：（max horizontal complexity － min horizontal complexity）＜（max vertical complexity － min vertical complexity）＋th2 のとき、max vertical complexity を持つ角度を入力文書の傾きの角度とする。

【００４６】（max horizontal complexity － min horizontal complexity）＋th2 ＞（max vertical complexity － min vertical complexity）のとき、max horizontalcomplexity を持つ角度を入力文書の傾きの角度とする。

【００４７】それ以外のとき、入力文書の傾き角を検出不能（判別不能）とする。ここで、th2 ：しきい値とする。

【００４８】＜判別方法３＞：sum horizontal complexity ＜ sum vertical complexity ＋th3 のとき、max vertical complexity を持つ角度を入力文書の傾きの角度とする。

【００４９】sum horizontal complexity ＋th3 ＞ sum vertical complexity のとき、max horizontal complexity を持つ角度を入力文書の傾きの角度とする。

【００５０】それ以外のとき、入力文書の傾き角を検出不能（判別不能）とする。

【００５１】＜判別方法４＞：
if（判別方法１が判別不能でない）　判別方法１の結果を採用する。

【００５２】else if （判別方法１が判別不能）
if（判別方法２が判別不能でない）　判別方法２の結果を採用する。

【００５３】else if （判別方法２が判別不能）
if（判別方法３が判別不能でない）　判別方法３の結果を採用する。
else if （判別方法３が判別不能）
入力文書の傾き角を検出不能（判別不能）とする。

【００５４】判定部７で行われる判定処理は第１実施例と同様であるので説明を省略する。以上の処理手続きを用いると入力文書の傾きを検出する前に予め文字列方向が未知であっても入力文書の傾きを正確に検出できる。

【００５５】また、以上の処理を適用した結果、max horizontal complexity を持つ角度を入力文書の傾きの角度とする場合には、入力文書の文字列方向を水平方向とし、max vertical complexity を持つ角度を入力文書の傾きの角度とする場合には、入力文書の文字列方向を垂直方向とすることにより入力文書の文字列方向を判別して、その判別結果を後段の文書読み取り装置に供給するようにしても良い。ただし、この場合、入力文書に記載されている文字列の方向は水平方向あるいは垂直方向のどちらか一方に限る。

【００５６】＜第３実施例＞第１実施例で説明した方式で、例えば角度分解能を0.1 度として入力文書の傾き角度を検出する場合には、例えば、角度分解能が１度のときの入力文書の傾き角Θ1 の付近（例えば　Θ1 －0.5 ≦ θ ≦ Θ1 ＋0.5 の範囲）で、さらに角度分解能を0.1 度として入力文書の詳細な傾き角度を検出しなければならない。したがって、第１実施例で説明した方式は所望の角度分解能を0.1 度以下とした場合には処理時間がかかることになる（例えば、＜傾き検出方式２＞では、さらにステップ１およびステップ２を１１回余計に適用しなければならない）。そこで、ここでは0.1 度の角度分解能で傾き検出処理を高速に行う方法である＜傾

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き検出方式4＞について説明する。＜傾き検出方式4＞は、第1実施例で説明した方式により1度の角度分解能で入力文書の傾き角度Θ1 を検出した後、Θ1 の複雑度：max complexityとΘ1 －1° の複雑度：before complexity とΘ1 ＋1° の複雑度after complexityの3つの複雑度から近似推論あるいはファジィ推論を用いて角度分解能が0.1 度以下のときの傾き角度Θ2 がΘ1 －0.5 以上Θ1 ＋0.5 以下の範囲のどの角度であるかを推定する。

【0057】第1傾き検出部で得られたmax complexity、before complexity 、after complexity等の値は、それぞれ信頼性の高い正確な値であると保証されているわけではない。したがって本方式ではこのような不正確な値にふさわしく、情報を曖昧な形のまま効率的に処理して、妥当な結果を得ることを目的する。本方式で示す上記のような曖昧さを含む角度検出アルゴリズムは「ｉｆ　前件部　ｔｈｅｎ後件部」の形式の複数個のルールによる推論と推論結果を解釈して傾き角度を推定する手続きからなる。以下、図8のブロック図にしたがって、＜傾き検出方式4＞について説明する。

【0058】＜傾き検出方式4＞：図8に示すブロック図の2値化処理部2から第1傾き検出部16までにおいて実施される処理は第1実施例で説明した方式によるものである。ただし第1傾き検出部16は、角度分解能をσ＝1度として入力文書の傾き角度を検出するものである。

【0059】第2傾き検出部17では、第1傾き検出部＊

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＊16からmax complexity、before complexity 、after complexityおよびΘ1 、Θ1 －1、Θ1 ＋1を受け取る。そして、この6つの値に対して、例えば、以下に示す曖昧な変数を含む3つのルールを用いることにより角度分解能を0.1 度としたときの入力文書の傾き角度を検出する。ここで、before complexity とafter complexityのうち大きい方をsecond complexity とする。

【0060】ルール1：before complexity とafter complexityの差が小さいならば、Θ2は、Θ1 の付近にある。

【0061】ルール2：second complexity とmax complexityの差が小さいならば、Θ2 は、Θ1 とsecond complexity を持つ角度の真ん中にある。

【0062】ルール3：second complexity とmax complexityの差が大きいならば、Θ2 は、Θ1 の付近にある。

【0063】上記3つのルールにおけるアンダーライン部の曖昧な変数は、ルール中に含まれる前件部および後件部の命題の真偽に関する度合いを区間［0，1］のある値で表現する。

【0064】上記ルールは実際の処理においては次のように表現される。

【0065】

ルール1：If diff1 is A1 then Θ2 is B1 .
ルール2：If diff2 is A2 then Θ2 is B2 .
ルール3：If diff2 is A3 then Θ2 is B1 .

$$\mathrm{diff1} = |\,\text{before complexity} - \text{after complexity}\,| \quad \cdots(3)$$

$$\mathrm{diff2} = \text{max complecity} - \text{second complecity} \quad \cdots(4)$$

$$A1 = 1 - \mathrm{diff1} \times 10 / \text{max complecity}$$
（ただし、A1 ＜0のとき、A1 ＝0とする）。 …(5)

$$A2 = 1 - \mathrm{diff1} \times 10 / \text{max complecity}$$
（ただし、A2 ＜0のとき、A2 ＝0とする。） …(6)

$$A3 = 1 - A2 \quad \cdots(7)$$

$$B1 = \begin{cases} 2\times\theta - 2\times\Theta1 + 1 & (\Theta1 - 0.5 \leqq \theta \leqq \Theta1 \text{ のとき}) \\ -2\times\theta + 2\times\Theta1 + 1 & (\Theta1 < \theta \leqq \Theta1 + 0.5 \text{ のとき}) \end{cases} \quad \cdots(8)$$

$$B2 = \text{if second complexity を持つ角度 is } \Theta1 - 1 \text{ then } \begin{cases} 2\times\theta - 2\times\Theta1 + 2 & (\Theta1 - 1 \leqq \theta \leqq \Theta1 - 0.5 \text{ のとき}) \\ -2\times\theta + 2\times\Theta1 & (\Theta1 - 0.5 < \theta \leqq \Theta1 \text{ のとき}) \end{cases} \quad \cdots(9)$$

$$\text{else if second complexity を持つ角度 is } \Theta1 + 1 \text{ else if second complexity を持つ角度 is } \Theta1 + 1 \text{ then } \begin{cases} 2\times\theta - 2\times\Theta1 & (\Theta1 \leqq \theta \leqq \Theta1 + 0.5 \text{ のとき}) \\ -2\times\theta + 2\times\Theta1 + 2 & (\Theta1 + 0.5 < \theta \leqq \Theta1 + 1 \text{ のとき}) \end{cases} \quad \cdots(10)$$

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ここで、｜k｜はkの絶対値とする。また、A1は「before complexity とafter complexityの差が小さい」ということを表現しているメンバーシップ関数で、A1＜0となるときA1＝0とし、A2は「second complexity とmax complexityの差が小さい」ということを表現しているメンバーシップ関数で、A2＜0となるときA2＝0とし、A3は「second complexity とmax complexityの差が大きい」ということを表現しているメンバーシップ関数である。B1は「θ1の付近」ということを表現するメンバーシップ関数（図9中B1に相当）であり、B2は「θ1とsecond complexity を持つ角度の真ん中」ということを表現しているメンバーシップ関数（図9中B2に相当）である。

【0066】＜傾き検出方式4＞は、まず各ルールごとに推論を実行し、推論結果を得る。各ルールにおける推論結果は各ルールの後件部の真偽の度合い（すなわちメンバーシップ関数）を表しており、次にこれを統合する（統合により得られたメンバーシップ関数をB'とする）。そして統合された推論結果をメンバーシップ関数＊

$$B1' = A1 \quad \wedge \quad B1$$

これは、具体的には、メンバーシップ関数B1を図10のようにA1でカットすることである。その結果B1'は、図10のようなメンバーシップ関数になる。　※

$$B2' = A2 \quad \wedge \quad B2$$

これは、具体的には、メンバーシップ関数B2を図11のようにA2でカットすることである。その結果B2'は、図11のようなメンバーシップ関数になる。

【0074】そして、B1'とB2'を統合し図12のようなメンバーシップ関数B'をつくる。

【0075】ステップ3：推論結果の解釈による傾き角度の推定。　★

$$y = (\int B'(\theta)\,\theta\,d\theta) / (\int B'(\theta)\,d\theta) \qquad \cdots(13)$$

上記＜傾き検出方式4＞で用いているルールは、その内容および個数の変更が可能である。また、各ルールで用いているメンバーシップ関数の変形も可能であり、必要に応じて変形を施しても良い。さらに前記メンバーシップ関数の代わりに学習済みのニューラルネットワークを用いることも可能である。その他、各ルールにおいて推論結果を導出する演算も既知の様々な方法を用いることができる。

【0078】＜第4実施例＞第1実施例では、本発明を文書読み取り装置に応用する場合、本発明による傾き検出方式により検出された入力文書の傾き角度を用いて入力文書を回転し、傾きを補正した入力文書画像を文書読み取り装置等に供給することとしている。この場合、傾き検出処理が所望の精度で検出され、さらに傾き補正処理により変換された画像が所望の精度（例えば0度±0.5度）以内に補正されているか否かを確認する機能を以下のように付加しても良い。上記確認機能を実現する処理手続きを図13を用いて説明する。

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＊B'の重心yを求めるという手段により解釈し、解釈結果を0.1度の角度分解能で検出された入力文書の傾き角度とする。以下に、具体的な計算方法について説明する。

【0067】ステップ1：各ルールの前件部の適合度の計算および適用ルールの選択。

【0068】ルール1においてA1の値（ルール1の前件部の適合度とする）を求め、ルール2においてA2の値（ルール2の前件部の適合度とする）を求め、ルール3においてA3の値（ルール3の前件部の適合度とする）を求める。ここで、A1≧A3のとき、ルール3は適用しないこととし、A1＜A3のとき、ルール3をルール1として適用することとする（以下の計算では、ルール1とルール2のみが用いられることとなる）。

【0069】ステップ2：各ルールの推論結果の算出と統合。

【0070】まず、ルール1の適合度A1を次の(11)式に適用してルール1の推論結果B1'を求める。

【0071】

$$\cdots(11)$$

※【0072】次に、ルール2の適合度A2を次の(12)式に適用してルール2の推論結果B2'を求める。

【0073】

$$\cdots(12)$$

★【0076】各ルールにおける推論結果の適合度による重み付け平均すなわち「メンバーシップ関数B'の重心y」を次の(13)式によって求めることにより推論結果の解釈を行う。そして、重心yを入力文書の傾き角度とする。

【0077】

【0079】図13中の入力文書画像傾き検出部8において実施される黒画素融合処理と局所領域抽出処理とデータ管理処理と判定処理は実施例1で述べたものと同様であり、傾き検出処理は前記＜傾き検出処理方式1～4＞のうちいずれかの方式による処理と同様であるので説明を省略する。次の文書画像回転処理部18では、上記傾き検出処理で検出された入力文書の傾き角を用いて、例えば「座標の平行移動による画像の高速回転法」（電学論C，105，3，pp.61-68，1985）などの方法により入力文書画像の回転処理が実施される。そして、その後に再度上記傾き検出処理を前記回転された画像に対して施し、その傾きを検出する。確認処理部19では、前記回転された画像の傾き角度が所望の誤差範囲内の所望の角度（例えば0度±0.5度以内）であるならば、前記回転された入力文書画像を後段の文書読み取り装置に供給し、前記回転された画像の傾き角度が所望の誤差範囲内の所望の角度でなければ入力文書の再入力をユーザーに促すようにする。

【００８０】また、以上の処理手続きを図１４のような手続きにしても良い。すなわち、図１４の処理手続きは、上記傾き回転処理と上記傾き検出処理と上記確認処理を回転された画像の傾き角度が所望の誤差範囲内の所望の角度となるまで繰り返し行うものである。このときｈ回繰り返しても回転された画像の傾き角度が所望の誤差範囲内の所望の角度にならなければ入力文書の再入力をユーザーに促すようにしている。

【００８１】なお、本発明はその要旨を逸脱しない範囲において種々変形して実現し、各種用途にしようする事ができる。

【００８２】

【発明の効果】以上説明したように、本発明の文書画像傾き検出方式では、入力文書の複雑さを調べることにより入力文書の傾きを検出するので、複雑さが文字列部に対して比較的小さい図・写真・ノイズなどによる影響を受けずに安定した傾き検出処理を実現できる。

【００８３】また、本発明の文書画像傾き検出方式では、自動的に抽出された文字列が大半を占める局所領域に対して階層的に効率良く傾き検出処理を行うのでコストパフォーマンスが著しく改善されるという効果が得られる。

【図面の簡単な説明】

【図１】本発明が適用された文書傾き検出方式の一実施例の構成を示すブロック図である。

【図２】入力文書画像をｎ個×ｍ個のメッシュに分割した例を示す説明図である。

【図３】入力文書画像における局所領域の抽出例を示す説明図である。

【図４】入力文書画像をｎ個の水平方向に長い帯領域に等分割した例を示す説明図である。

【図５】入力文書画像の領域Ｓ１を垂直方向に長い帯領域に等分割した例を示す図説明図である。

【図６】ランレングス符号の構造を示す説明図である。

【図７】水平および垂直の両方向に入力文書の傾きを検出する文書傾き検出方式の構成を示すブロック図である。

【図８】文書傾き検出方式の別の構成を示すブロック図である。

【図９】文書傾き検出処理に用いるメンバーシップ関数の一例を示す説明図である。

【図１０】一つのルールの推論結果により得られるメンバーシップ関数の一例を示す説明図である。

【図１１】一つのルールの推論結果により得られるメンバーシップ関数の一例を示す説明図である。

【図１２】推論結果を統合して得られるメンバーシップ関数の一例を示す説明図である。

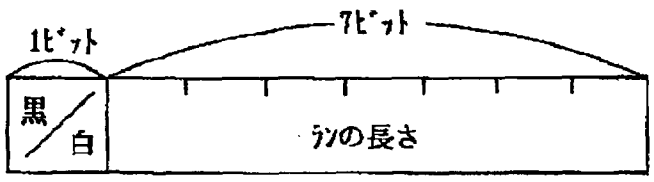
【図１３】確認機能を組み込んだ文書傾き検出方式の構成を示す図である。

【図１４】確認機能を組み込んだ文書傾き検出方式の別の構成を示す図である。

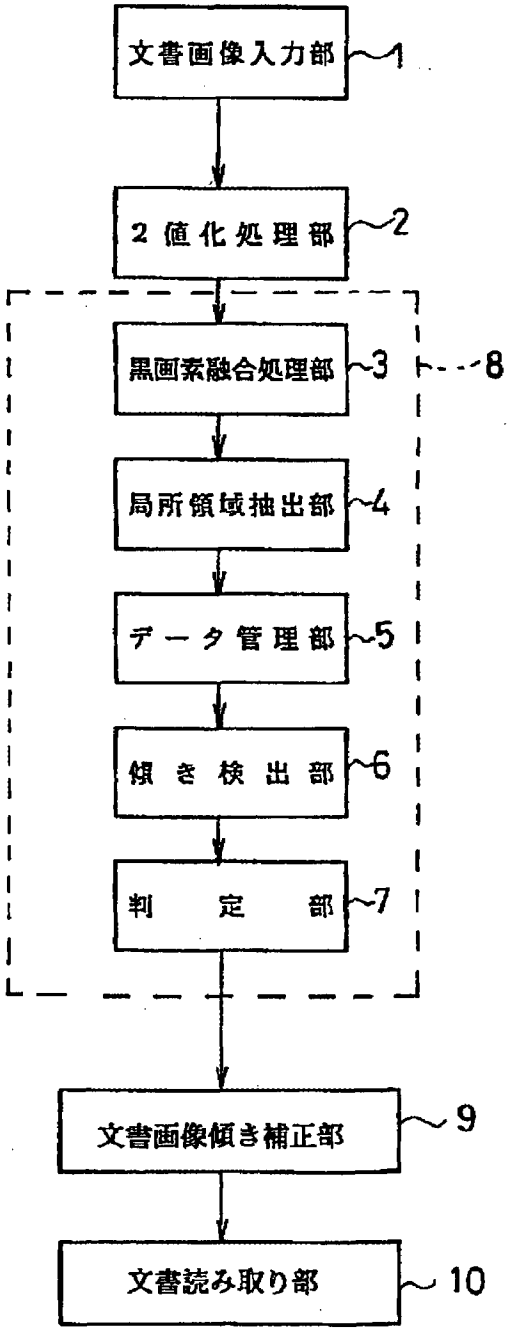
【符号の説明】

１　文書画像入力部
２　２値化処理部
３　黒画素融合処理部
４　局所領域抽出部
５　データ管理部
６　傾き検出部
７　判定部
８　文書画像傾き検出部
９　文書画像傾き補正部
１０　文書読み取り部
１１　水平方向データ管理部
１２　垂直方向データ管理部
１３　水平方向傾き検出部
１４　垂直方向傾き検出部
１５　傾き方向判定部
１６　第１傾き検出部
１７　第２傾き検出部
１８　文書画像回転処理部
１９　確認処理部

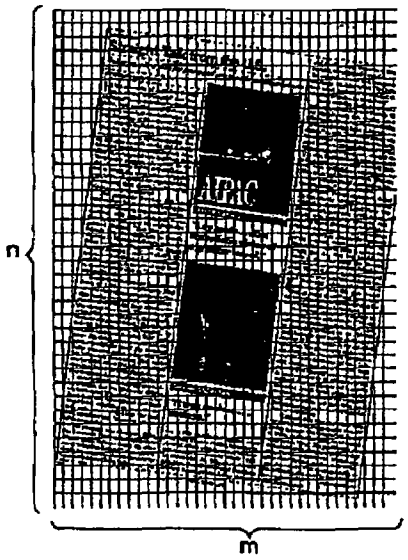
【図６】



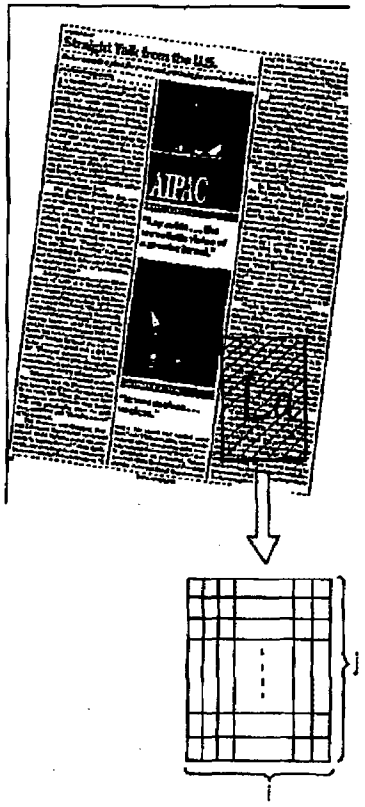
【図1】


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
8
局所領域抽出部
4
データ管理部
5
傾き検出部
6
判定部
7
文書画像傾き補正部
9
文書読み取り部
10

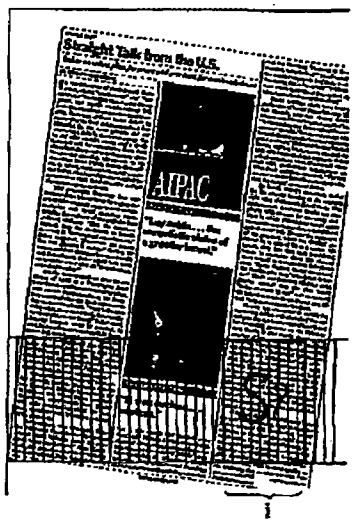
【図2】



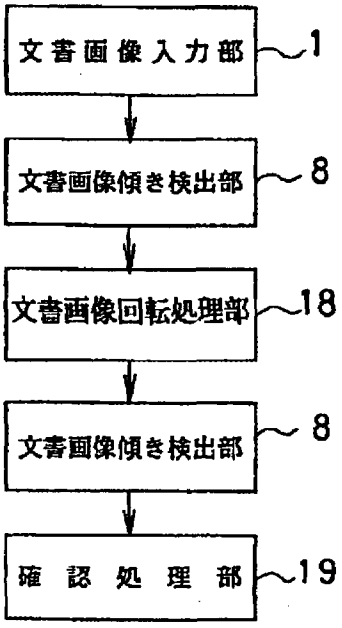
【図3】



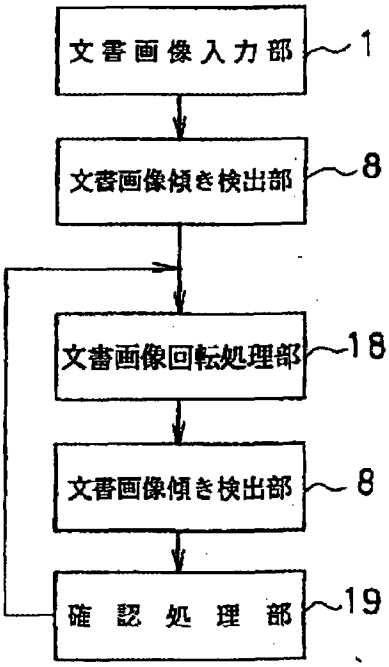
【図5】



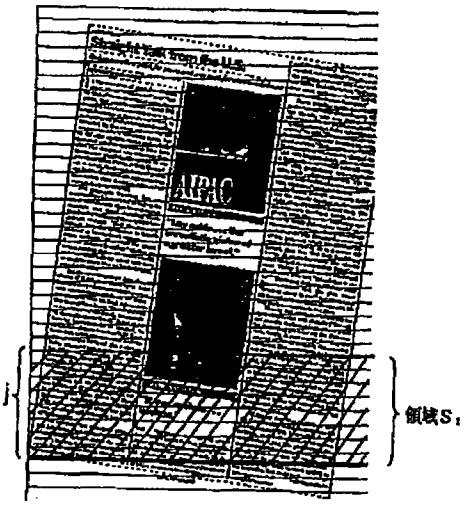
【図13】



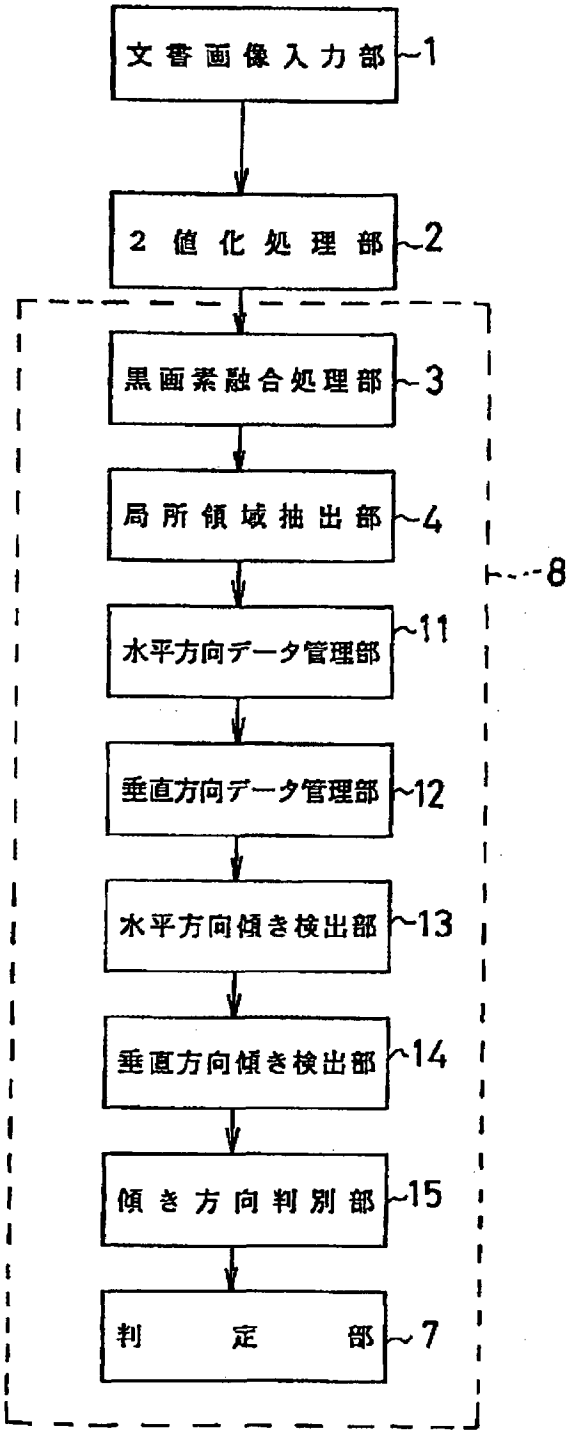
【図14】



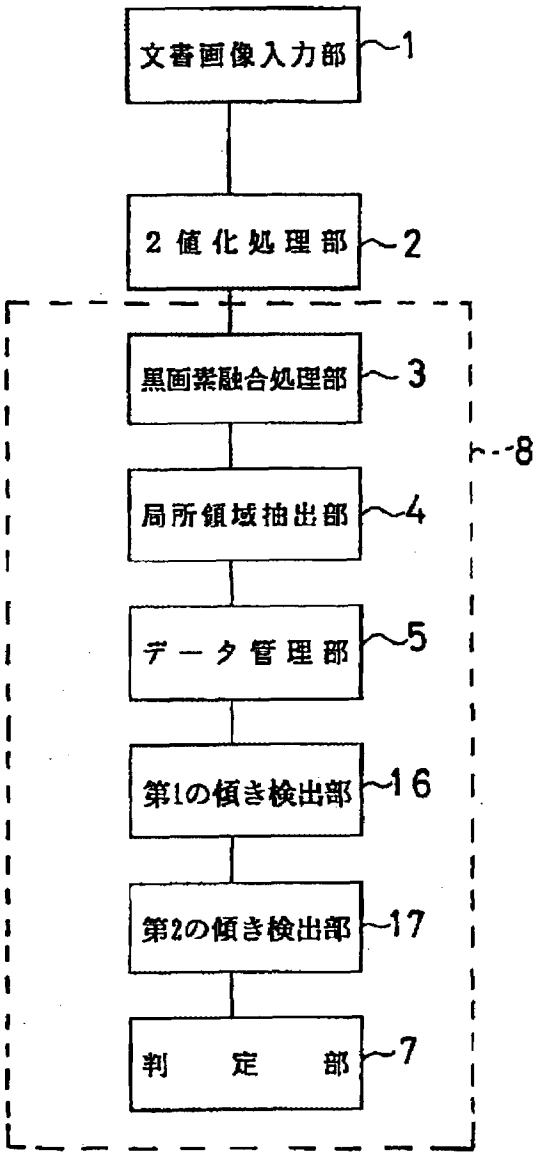
【図4】


領域S1

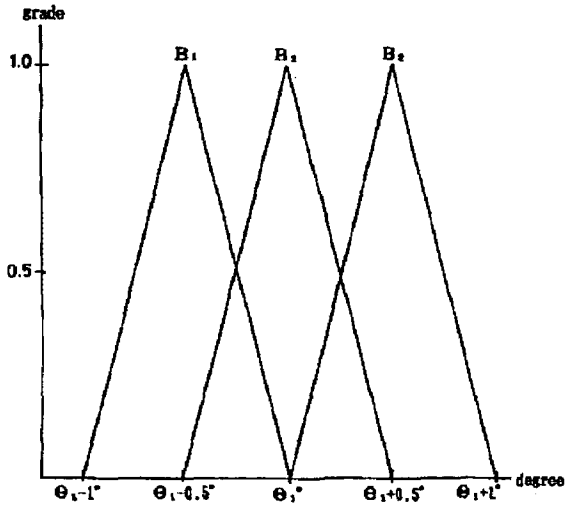
【図7】


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
局所領域抽出部
4
8
水平方向データ管理部
11
垂直方向データ管理部
12
水平方向傾き検出部
13
垂直方向傾き検出部
14
傾き方向判別部
15
判定部
7

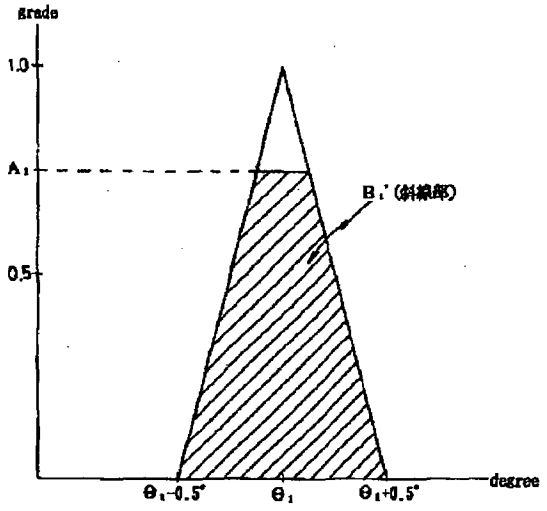
【図8】


文書画像入力部
1
2値化処理部
2
黒画素融合処理部
3
局所領域抽出部
4
データ管理部
5
第1の傾き検出部
16
第2の傾き検出部
17
判　定　部
7
8

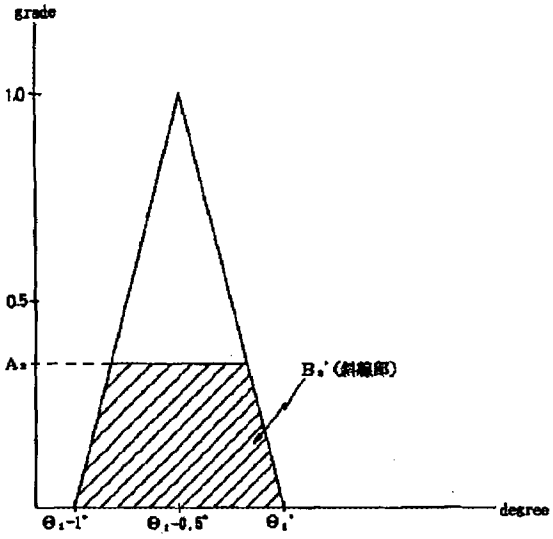
【図9】


grade
1.0
0.5
B₁
B₂
B₃
θ₁-1°
θ₁-0.5°
θ₁°
θ₁+0.5°
θ₁+1°
degree

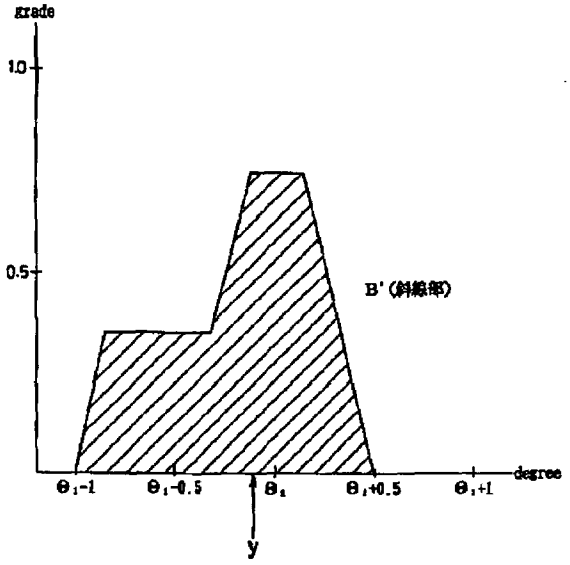
【図10】


grade
1.0
A₁
0.5
B₁'(斜線部)
θ₁-0.5°
θ₁
θ₁+0.5°
degree

【図１１】


grade
1.0
0.5
A₀
B₀'(斜線部)
degree
θ₁-1°
θ₁-0.5°
θ₁°

【図１２】


grade
1.0
0.5
B'(斜線部)
degree
θ₁-1
θ₁-0.5
θ₁
θ₁+0.5
θ₁+1
y

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第６部門第３区分
【発行日】平成１１年（１９９９）１０月２９日

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【年通号数】公開特許公報５－１７４２
【出願番号】特願平３－３４５４１９
【国際特許分類第６版】
G06K　9/32
【ＦＩ】
G06K　9/32

【手続補正書】
【提出日】平成１０年１２月２５日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】発明の名称
【補正方法】変更
【補正内容】
【発明の名称】　文書画像傾き検出装置およびその方法
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　複数の角度方向ごとに文書画像の複雑度を抽出する手段と、最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとする手段とを具備したことを特徴とする文書画像傾き検出装置。
【請求項２】　前記複雑度を抽出する手段は、任意の角度方向に前記文書画像を走査して、１本の走査線上で白画素から黒画素または黒画素から白画素に変化する回数を計数し、それを前記文書画像全体で加算した値を任意の角度方向の複雑度とする請求項１記載の文書画像傾き検出装置。
【請求項３】　文書画像中で文字列が大半を占める局所領域を抽出する手段と、前記局所領域の複雑度を複数の角度方向ごとに抽出する手段と、前記抽出された複雑度から最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとする手段とを具備したことを特徴とする文書画像傾き検出装置。
【請求項４】　文書画像をｎ個×ｍ個のメッシュに分割する手段と、各メッシュ内において１本の走査線上で白画素から黒画素または黒画素から白画素に変化する回数を計数する手段と、最も多くの前記白画素から黒画素または黒画素から白画素に変化する回数となる走査線を含むp連続なｉ個×ｊ個の局所領域を前記文字列が大半を占める局所領域として抽出する手段とを具備した請求項３記載の文書画像傾き検出装置。
【請求項５】　文書画像全体またはその一部分である局所領域において複数の角度方向に文書画像の複雑度を抽出する際に、α度の角度分解能でいくつかの角度方向の複雑度を求め、これらのうち最も複雑度の大きい角度方向を抽出する手段と、前記最も複雑度の大きい方向の角度付近をα度より小さいσ度の角度分解能で複数の方向に複雑度を求め、それらのうち最も複雑度の大きい方向の角度を文書画像の傾きとして抽出する手段を具備した請求項１記載の文書画像傾き検出装置。
【請求項６】　文書画像全体またはその一部分である局所領域をσ度の角度分解能で複数方向に走査して各角度方向ごとに複雑度を抽出する手段と、最大複雑度を持つ方向の角度θ_{max}の複雑度と$\theta_{max}-\sigma$度の複雑度および$\theta_{max}+\sigma$度の複雑度の３つの複雑度の大きさの分布から前記文書画像の傾きをσより小さい角度分解能で推定する手段とを具備した請求項１記載の文書画像傾き検出装置。
【請求項７】　文書画像を２値化する手段と、水平または垂直方向の少なくとも一方にて、各走査線ごとに黒画素に挟まれた長さδ画素以下の連続する白画素をすべて黒画素に変換して近接する黒画素を融合する手段と、前記変換された文書画像に対して、複数の角度方向に文書画像を走査して各方向ごとに前記文書画像の複雑度を抽出する手段と、最も複雑度が大きい方向の角度を検出し、これを前記入力文書画像の傾きとする手段とを具備したことを特徴とする文書画像傾き検出装置。
【請求項８】　複数の角度方向ごとに文書画像の複雑度を抽出し、最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとすることを特徴とする文書画像傾き検出方法。
【請求項９】　文書画像中で文字列が大半を占める局所領域を抽出し、前記局所領域の複雑度を複数の角度方向ごとに抽出し、前記抽出された複雑度から最も複雑度が大きい方向の角度を検出し、その角度を前記文書画像の傾きとすることを特徴とする文書画像傾き検出方法。

【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】０００１
【補正方法】変更
【補正内容】

【０００１】
【産業上の利用分野】本発明は、文書読み取り装置または文書ファイリング装置等に文書を入力する際に入力文書の傾きを検出し、補正する文書画像傾き検出装置およびその方法に関する。